# EFFECT OF SHADE PERCENTAGE ON VARIOUS PROPERTIES OF COTTON KNITTED FABRIC DYED WITH REACTIVE DYES

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## Abstract

*Shade percentage is an important factor which has various impacts on cotton knitted fabric. The technical factors GSM, CPI (Course per Inch), WPI (Wales per inch), shrinkage percentage, color fastness of cotton knitted fabric are influenced by various shade percentage. The main objective of this paper was to find out that various technical factors. The cotton knitted bleached fabric (plain single jersey, single lacoste, three thread fleece & rib) which were dyed by reactive dye using auxiliaries, then measured various GSM, CPI, WPI & their fastness properties of above fabric. It was observed that after increasing the shade percentage on cotton knitted fabric, GSM, CPI, WPI and shrinkage were increased, both lengthwise and widthwise shrinkage of all fabrics were occurred. It was also observed that, with the increase of shade amount decrease the color fastness of cotton knitted fabric.*

***Keywords:*** *Shade, Knitted fabric, Cotton, Reactive dye, GSM (Gram per Square meter).*

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## 1. INTRODUCTION

The use of knitted fabric has been rapidly increasing in world wide. Both men & women feel comfortable wearing knitted fabric for their shape fitting properties, softer handle, bulkier nature and high extension at low tension compared to woven fabric [1].

Cotton today is the most used textile fiber in the world. Its current market share is 56% for all fibers used for apparel and home furnishings and sold in the U.S. Another contribution is attributed to nonwoven textiles and personal care items. It is generally recognized that most consumers prefer cotton personal care items to those containing synthetic fibers. Current estimates for world productions are about 25 million tones or 110 million bales annually, accounting for 2.5% of the world's arable land. China is the world's largest producer of cotton, but most of this is used domestically. The United States has been the largest exporter for many years [2].

In recent years, reactive dyes have been most commonly used the reactive dyes are the best for cotton for its wide range of application and better fastness properties [3]. There for 50% of cellulosic fibers are dyed with reactive dyes. Share of reactive dyes among all textile dyes is 29%. Due to their strong interaction with many surfaces of synthetic and natural fabrics, reactive dyes are used for dyeing wool, cotton, nylon, silk, and modified acrylics [4-5]. In Bangladeshi wet processing industries, reactive dyes are hugely used. The reactive site of the dyes reacts with functional group on fiber under influence of heat and alkali [6]. Fiber reactive dyes react with the cellulosic fiber in the presence of alkali to form a strong covalent chemical bond between a carbon atom of the dye molecule and an oxygen atom of the hydroxyl group in the cellulose. Reactive dyes typically form covalent ether linkages between the dye and the substrate when subjected to the proper conditions. Reactive dyes are popular in textile manufacturing due to their fastness properties.

In this research we use cotton weft knitted (plain single jersey, single lacoste, three thread fleece and rib) fabric & reactive dyes. All of the samples were dyed by reactive dyes (Fucozol Red E5BN, Fucozol Blue RN Special), then GSM, CPI, WPI, Shrinkage & various color fastness properties were measured.

## 2. EXPERIMENTATION:

### 2.1 MATERIAL

#### 2.1.1 Sample Preparation:

In this research various weft knitted fabric samples were prepared from Antim Knit Composite Ltd. Four types of samples were prepared including plain single jersey, single lacoste, three thread fleece and rib. These fabrics were made from cotton yarn, GSM about 150 to 260.

#### 2.1.2 Dye Stuff and Chemicals:

The chemicals and dye stuff were collected from Antim Knit Composite Ltd. and used without any further treatment.

- Reactive Dye.
    - Fucozol Red E5BN
    - Fucozol Blue RN Special
- Electrolyte: Gluber salt (Na2SO4. 10 H2O)
- Alkali: Soda ash ($Na_2CO_3$).
- Soaping agent ( SW CONE)
- Acetic Acid (100%).

## 2.2 METHODS

In this research, the following procedure has been followed.

### 2.2.1 Dyeing of Samples with Reactive Dyes:

With a view to performing this research, we dyed the samples by variation in depth of shade of Reactive dye. These are

**Table 1**: Different shade% applied on samples

| Fabric | Variation in depth of shade | | |
|---|---|---|---|
| Plain single jersey | 1% | 3% | 5% |
| Single lacoste | 1% | 3% | 5% |
| Three thread fleece | 1% | 3% | 5% |
| Rib | 1% | 3% | 5% |

For this research, two reactive dyes were used for above shade%. These are

- Fucozol Red E5BN (66.67% of total amount of dye used)
- Fucozol Blue RN Special (33.33% of total amount of dye used)

### GSM and Other Structural Properties:

GSM (gram per square meter), CPI (course per inch), WPI (Wales per inch) of both grey and dyed weft knitted fabric evaluated and then compared. Shrinkage or dimensional change is measured by according to AATCC 135-2001 Test method.

### Fastness Measurement:

In this research, the following fastness properties were measured [7-10].

- Color fastness to wash (ISO 105 C04 B2S)
- Color fastness to water (ISO 105 E01)
- Color fastness to rubbing (ISO 105 X12)
- Color fastness to light (ISO 105 B02)

The dyeing of samples carried out by using exhaust brand Reactive dyes on lab dyeing machine keeping material to liquor ratio 1:10 for the shade percentage 1, 3 & 5%. All dyeing were performed as per the standard method prescribes by the manufacturers. The pH of the dye bath was adjusted with 20 g/l soda ash. At first we marked 12 dyeing pot for the 12 samples. Set the bath with substrate at room temperature 40°c and add sample, dyes soda ash and salt. Then raise the temperature at 60°c at 1°/minute. Run the dyeing for 60 minutes at as same temperature 60°c. Decrease the temperature from 60°c to room temperature. Then dropped the samples from bath and rinsed and then carried on after treatment process. After dyeing the samples washed by hot water with S.W. Cone (detergent) & rinsed. Then the samples washed with cold water & neutralized by 1g/l acetic acid (100%) for 10 minutes. Dry the sample by incubator (dryer). GSM of fabrics were measured with the help of GSM cutter & electric balance.CPI & WPI are evaluated by counting glass. Then the color fastness to wash, water, rubbing, perspiration and light were measured by ISO 105 C04 B2S, ISO 105 E01, and ISO 105 X12 and ISO 105 B02 [7-10] test method respectively.

## 3. RESULTS AND DISCUSSION

All the tests were performed in the standard testing atmosphere i.e. 65±2% R.H. and 20◦C. Four types of weft knitted fabric samples (plain single jersey, single lacoste, three thread fleece & rib) were taken for this experiment. The results of different test of different samples are given bellow.

Areal density (GSM) of samples for different shade percentage:

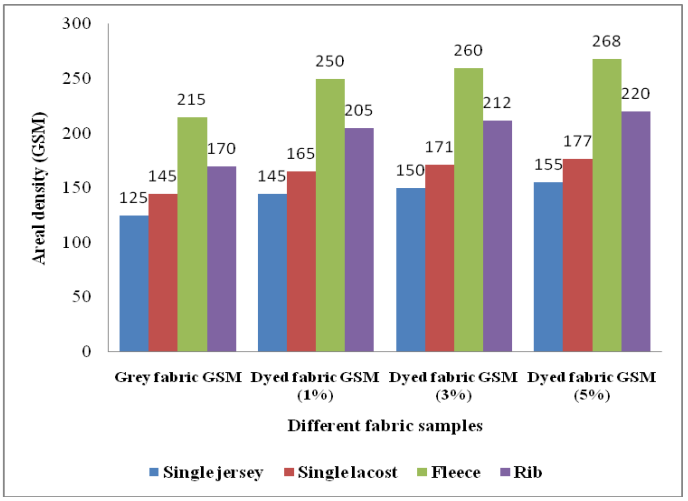


**Fig 1:** Areal density (GSM) of samples for different shade

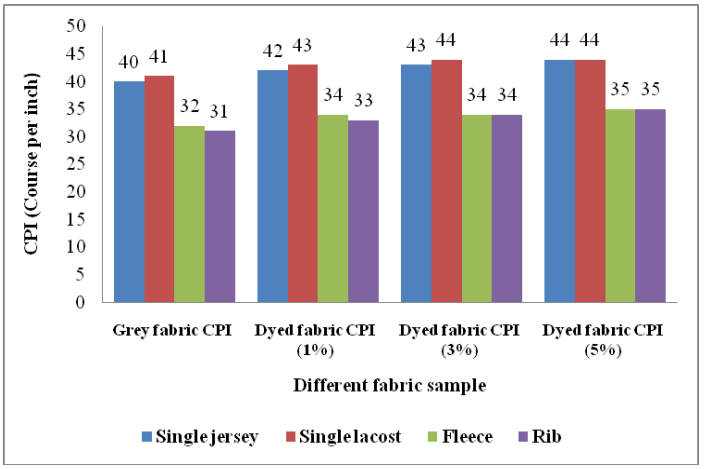


**Fig 2:** Course per inch (CPI) of samples for different shade.

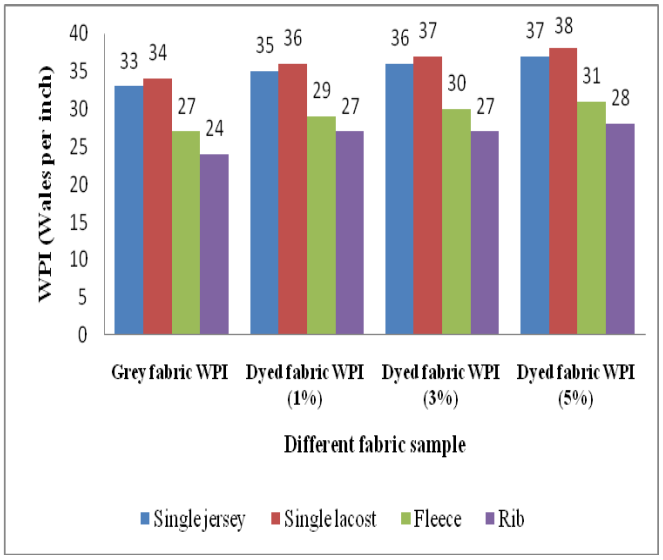


**Fig 3:** Wales per inch (WPI) of samples for different shade

Effect of shade% on cotton knitted fabric shown in the chart-I, II and III it is seen that with the increase of shade ( 1%, 3% and 5%) on weft knitted fabric (plain single jersey, single lacoste, three thread fleece & rib) GSM, CPI and WPI of all the fabric increase.

**Table 2**: Shrinkage measurement for different shade on cotton knitted fabric.

| Fabric type | Shade% | Length wise Shrinkage | Width wise shrinkage |
|---|---|---|---|
| Plain single jersey | 1% | -3% | -4% |
| | 3% | -5% | -5% |
| | 5% | -6% | -7% |
| Single lacoste | 1% | -2% | -3% |
| | 3% | -4% | -4% |
| | 5% | -5% | -5% |
| Three thread fleece | 1% | -4% | -3% |
| | 3% | -5% | -5% |
| | 5% | -6% | -6% |
| Rib | 1% | -3% | -3% |
| | 3% | -4% | -6% |
| | 5% | -6% | -7% |

In above table, shows that with the increase of shade both length & width wise shrinkage are occurred.

## 3. RESULT AND DISCUSSION

### 3.1 Analysis of Fastness Properties

**Table 3:** Color fastness to wash for different shade on knitted samples

| Fabric type | Shade % | Color change | Color staining | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Acetate | Cotton | Nylon | Polyester | Acrylic | Wool |
| Plain single jersey | 1% | 4-5 | 4-5 | 4 | 4-5 | 4-5 | 4-5 | 4-5 |
| | 3% | 4 | 4-5 | 4 | 4-5 | 4-5 | 4-5 | 4 |
| | 5% | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Single lacoste | 1% | 4-5 | 4-5 | 4-5 | 4-5 | 4-5 | 4-5 | 4-5 |
| | 3% | 4 | 4-5 | 4 | 4-5 | 4-5 | 4-5 | 4 |
| | 5% | 4 | 4-5 | 4 | 4-5 | 4 | 4 | 4 |
| Three thread fleece | 1% | 4-5 | 4-5 | 4 | 4-5 | 4-5 | 4-5 | 4-5 |
| | 3% | 4 | 4 | 4 | 4 | 4-5 | 4-5 | 4 |
| | 5% | 4 | 4 | 3-5 | 4 | 4-5 | 4 | 3-5 |
| Rib | 1% | 4-5 | 4-5 | 4 | 4-5 | 4-5 | 4-5 | 4-5 |
| | 3% | 4 | 4-5 | 4 | 4-5 | 4-5 | 4-5 | 4 |
| | 5% | 4 | 4 | 4 | 4 | 4-5 | 4 | 4 |

From that table, the results of Color fastness to wash of cotton knitted fabric for different shade have been showed. Wash fastness of cotton knitted fabric decrease with the increases of shade. Here for color staining, Acetate, Nylon, polyester, Acrylic are almost same. But cotton and wool show considerable color change.

**Table 4:** Color fastness to water for different shade on cotton knitted samples.

| Fabric type | Shade% | Color change | Color staining | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Acetate | Cotton | Nylon | Polyester | Acrylic | Wool |
| Plain single jersey | 1% | 4-5 | 4-5 | 4 | 4-5 | 4-5 | 4-5 | 4 |
| | 3% | 4 | 4-5 | 4 | 4-5 | 4-5 | 4-5 | 4 |
| | 5% | 4 | 4 | 4 | 4 | 4-5 | 4 | 3-4 |
| Single lacoste | 1% | 4-5 | 4-5 | 4-5 | 4-5 | 4-5 | 4-5 | 4-5 |
| | 3% | 4 | 4-5 | 4 | 4-5 | 4-5 | 4-5 | 4 |
| | 5% | 4 | 4-5 | 4 | 4-5 | 4-5 | 4 | 3-4 |
| Three thread fleece | 1% | 4-5 | 4-5 | 4 | 4-5 | 4-5 | 4-5 | 4-5 |
| | 3% | 4 | 4 | 4 | 4 | 4-5 | 4-5 | 4 |
| | 5% | 3-4 | 4 | 3-4 | 4 | 4-5 | 4 | 3-5 |
| Rib | 1% | 4-5 | 4-5 | 4 | 4-5 | 4-5 | 4-5 | 4-5 |
| | 3% | 4 | 4-5 | 4 | 4-5 | 4-5 | 4-5 | 4 |
| | 5% | 3-4 | 4 | 4 | 4 | 4-5 | 4 | 4 |

From the table, we see the result of Color fastness to water of cotton knitted fabric for different shade. Water fastness of cotton knitted fabric decrease with the increases of shade.

**Table 5:** Color fastness to rubbing for different shade on cotton knitted samples.

| Fabric type | Shade% | Dry rubbing | Wet rubbing |
|---|---|---|---|
| Plain single jersey | 1% | 4-5 | 4 |
| | 3% | 4-5 | 4 |
| | 5% | 4 | 3-4 |
| Single lacoste | 1% | 4-5 | 4 |
| | 3% | 4 | 4 |
| | 5% | 4 | 4 |
| Three thread fleece | 1% | 4-5 | 4-5 |

In this table, the result of Color fastness to rubbing (dry & wet) of cotton knitted fabric for different shade are observed.

**Table 6:** Color fastness to light for different shade on cotton knitted samples

| Fabric type | Shade% | Fastness Rating according to Blue wool Standard grading |
|---|---|---|
| Plain single jersey | 1% | 7 |
| | 3% | 6-7 |
| | 5% | 6 |
| Single lacoste | 1% | 7 |
| | 3% | 6-7 |
| | 5% | 6-7 |
| Three thread fleece | 1% | 7 |
| | 3% | 7 |
| | 5% | 6-7 |
| Rib | 1% | 7 |
| | 3% | 6-7 |
| | 5% | 6 |

In the above table, analysis shows the result of Color fastness to light of weft knitted fabric for different shade. Color fastness to light of weft knitted fabric decreases with the increases of shade

## 4. CONCLUSIONS

In this study, it was observed that, with the increase of shade, the structural properties of cotton knitted fabric (GSM, CPI, WPI and Shrinkage) are changed. Color fastness of weft knitted fabric is also affected by shade. With the increase of shade%, decrease the color fastness of cotton knitted fabric. So we can easily comment that, there is a considerable Effect of shade cotton knitted fabric with Reactive dyes.

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## BIOGRAPHIES

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