Analysis on the Effect of Shade percentage on Different properties of Cotton Knitted Three Thread Fleece and Rib Fabric

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Abstract: **The main objective of this paper was to find out how shade percentage influences the cotton knitted three thread fleece and rib fabric quality. These qualities depend on various technical factors like GSM, CPI (Course per Inch), WPI (Wales per inch), shrinkage percentage, loop length, dyeing finishing parameters and color fastness properties of cotton knitted fabric. The cotton knitted bleached fabric (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 wash fastness and rubbing fastness of cotton knitted fabric.**

Keywords: **Three thread fleece, Rib, Shade, Knitted fabric, Shrinkage, Reactive dye, GSM (Gram per Square meter).**

I. INTRODUCTION

The use of knitted fabric has been rapidly increasing in world wide. Both men and women feel comfortable to wear knitted fabric for their shape fitting properties, softer handle and high extension at low tension compared to woven fabric[1]. The fleece fabric is similar to jersey and is obtained by inserting one or more additional yarns which do not form the stitch but only a sort of binding on the ground pattern [2]. Current estimates for world productions of cotton 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 long years. 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]. Therefore approximately 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]. The darkness or lightness of color in dyeing known as depth of shade is dependent on the quality of dye used in the ratio to the fiber weight being dyed [7]. Most of the 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 form covalent bonds linkages. 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.

II. EXPERIMENTATION

II.I MATERIAL

II.I.I Sample preparation

In this research three thread fleece and rib fabric samples were prepared from Antim Knit Composite Ltd. Two types of samples were prepared including three thread fleece and rib. These fabrics were made from cotton yarn, GSM about 150 to 260.

II.I.II Yarn specification

Nominal count	Actual count	Types of yarn	TPI (Twist Per Inch)	Origin
22^s/1 Ne	21.89^s/1 Ne	Carded	16	Bangladesh

II.I.III Machine specification

Brand name	Jiunn Long
Country of Origin	Taiwan
Machine Diameter	26 inch
Number of feeder	78
Machine gauge	24
Number of needles	1960
Machine speed	30 rpm

II.I.IV Dye Stuff and Chemicals

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

- Reactive Dyes.
    - Fucozol Red E5BN
    - Fucozol Blue RN Special
- Electrolyte: Gluber salt (Na_2SO_4. 10 H_2O)
- Alkali: Soda ash (Na_2CO_3).
- Soaping agent (S.W. CONE)

II.II METHODS

In this research, the following procedure has been followed.

II.II.I 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		
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)

Fastness Measurement

In this research, the following fastness properties were measured [8-11].

- 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 and 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 10 dyeing pot for the 10 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 and 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.

III.RESULTS AND DISCUSSION

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

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

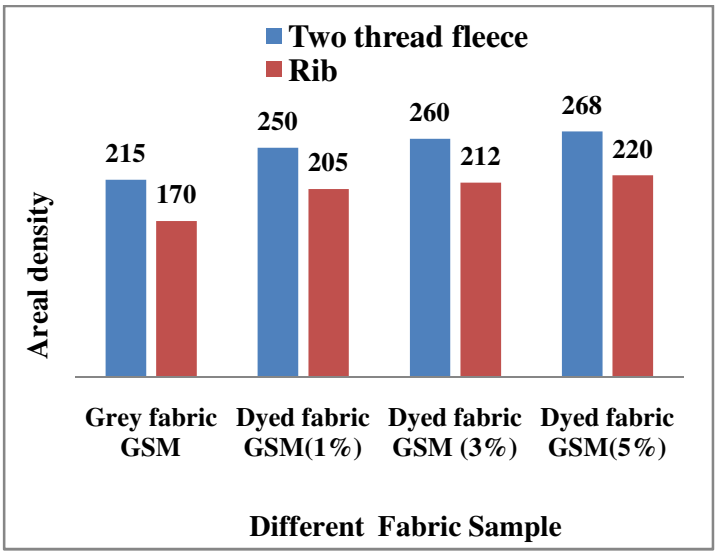

Figure 1: Areal density (GSM) of cotton knitted samples for different shade

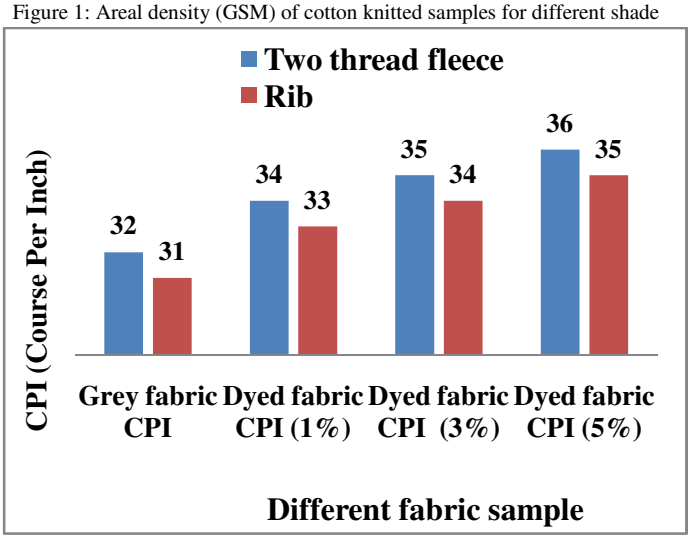

Figure 2: Course per inch (CPI) of cotton knitted samples for different shade.

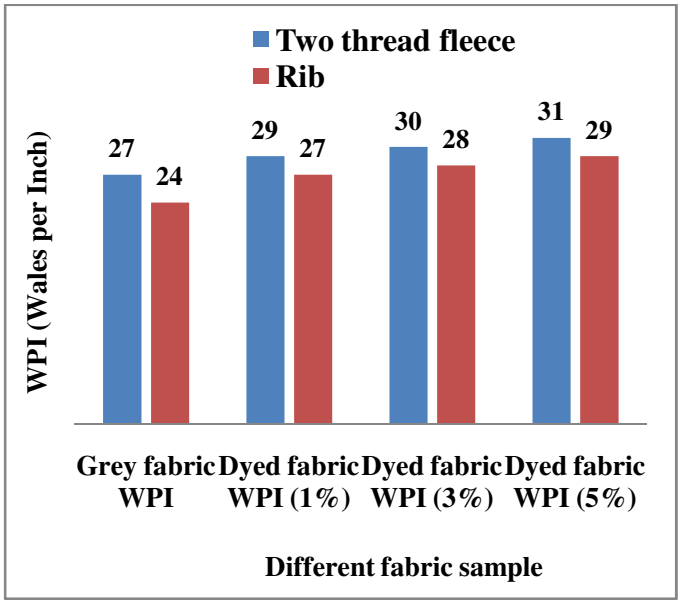

Figure 3: Wales per inch (WPI) of cotton knitted samples for different shade

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

Fabric type	Shade%	Length wise Shrinkage
Three thread fleece	1%	-4%
	3%	-5%
	5%	-6%
Rib	1%	-3%
	3%	-4%
	5%	-6%

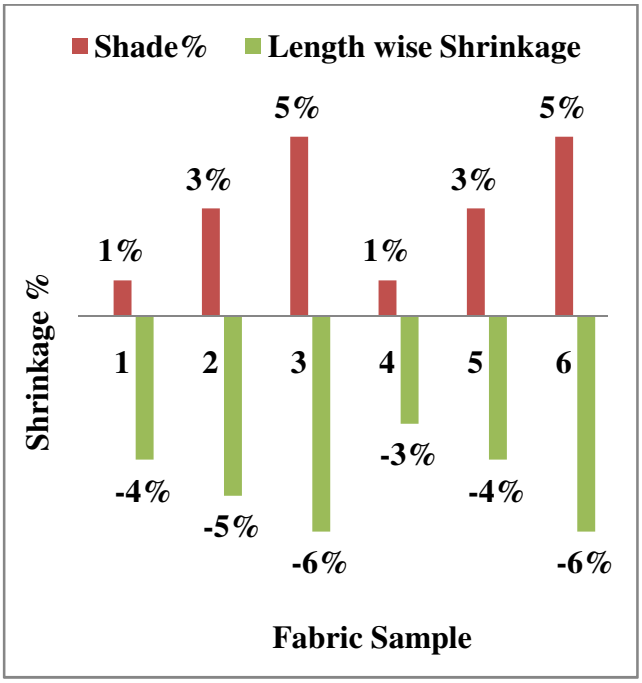

Figure 4: Lengthwise Shrinkage measurement

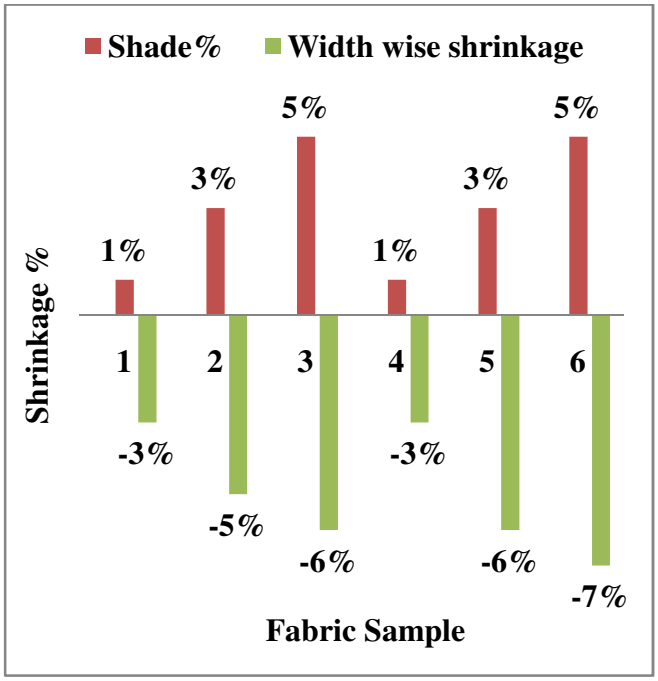

Figure 5: Widthwise Shrinkage measurement

Table 3: Widthwise Shrinkage measurement for different shade on cotton knitted fabric.

Fabric type	Shade%	Width wise Shrinkage
Three thread fleece	1%	-3%
	3%	-5%
	5%	-6%
Rib	1%	-3%
	3%	-6%
	5%	-7%

III.I Analysis of cotton samples fastness properties

Fastness is the resistance of a textile material to specific chemical agencies. Poor color in textile products is a major source of customer complaint. The fastness of a color can vary with the type of dye, the particular shade used, the depth of shade and how well the dyeing process has been carried out. Dyes can also behave differently when in contact with different agents, for instance dyes which may be fast to dry-cleaning may not be fast to washing in water. It is therefore important to test any dyed or printed product for the fastness of the colors that have been widely used.

Color fastness is usually assessed separately with respect to changes in the color of the specimen being tested, that is color fading. Staining of non dyed material which is in contact with the specimen during the test that is bleeding of color. In order to give a more objective result a numerical assessment of each of these effects is made by comparing the changes with two sets of standard grayscales, one for color change and the other for staining.

Table 4: Color fastness to wash for different shade percentage on cotton knitted samples

Fabric type	Shade%	Color change	Color staining					
			Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
Three thread fleece	1%	4-5	4-5	4	4-5	4-5	4-5	4-5
	3%	4	4	4	4	4	4-5	4
	5%	4	4	3-5	4	4	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	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 5: Color fastness to water for different shade percentage on cotton knitted samples.

Fabric type	Shade%	Color change	Color staining					
			Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
Three thread fleece	1%	5	4-5	4	4-5	4	5	5
	3%	4	4	4	4	4-5	4	4
	5%	4	4	3	4	5	4	3
Rib	1%	5	5	4	4-5	4-5	4-5	5
	3%	4	4-5	4	4-5	4	5	4
	5%	3-4	4	4	4	4	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 6: Color fastness to rubbing for different shade on cotton knitted samples

Fabric type	Shade%	Dry rubbing	Wet rubbing
Three thread fleece	1%	4-5	4
	3%	4	4
	5%	4	3-4
Rib	1%	4	4-5
	3%	4-5	4
	5%	4	4

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

Table 7: Color fastness to light for different shade on cotton knitted samples

Fabric type	Shade%	Fastness Rating according to Blue wool Standard grading
Three thread fleece	1%	7
	3%	6-7
	5%	6
Rib	1%	7
	3%	6
	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 three thread fleece and rib fabrics decrease with the increases of shade.

IV.CONCLUSION

In this study, it was observed that, increasing the percentage of shade, the structural properties of cotton knitted fabric (GSM, CPI, WPI and Shrinkage) are changed. Color fastness of cotton weft knitted fabric is also affected by shade. With the increase of shade percentage, 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.

V. ACKNOWLEDGEMENT

The authors would like to thank Md. Ali Akbar, Managing Director and Sabib Reza Tarafder (Papai), Director of Antim Knit Composite Ltd. for their good support, help and coordination at all points during our data collection.

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