IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 7, Issue 12, December 2020

DOI 10.17148/IARJSET.2020.71202

Effect of Blend Ratio and Relaxation on Structural Properties of Knitted Fabrics

Prof. A. U. Awasare[1], Prof. (Dr.) S. B. Mhetre[2], Mr. H. V. Chavan[3]*

D.K.T.E.S. Textile & Engineering Institute, Ichalkaranji, India

*Smartext Solution, Bangluru, India[1-3]

Abstract: The structural properties such as thickness, areal density and tightness factor of a series of polyester/cotton blended yarn knitted fabrics were analysed in an effort to determine physical basis of clothing comfort. Two types of samples were made; first 'before relaxation' and second 'after relaxation', to check whether the relaxation treatment affects these properties or not. The experimental results show that the fabric thickness, areal density, and tightness factor are affected by the fabric relaxation properties. Results observed were significantly affected by the relaxation treatment.

Keywords: Areal Density, Fabric Thickness, Tightness Factor, Wet Relaxation

1. INTRODUCTION

The fabric relaxation is one of the important states for the knitted fabric which decides the fabric stability. The dimensions of the fabric during knitting, after some days the fabric will be relaxed just by keeping it in free condition. The same fabric when wet relaxed, then the dimensions again changes which also affect the parameters of the fabric. In this study it has been studied the effect of the fabric relaxation on the parameters of the fabric knitted with different types of yarn i. e. 100% cotton to 100% polyester and their blends. The important properties affected are stitch density, stitch length, fabric thickness, tightness factor and the areal density of the interlock weft knitted fabric produced on circular knitting machine.

2. MATERIALS AND METHODS

2.1 Materials

100 % hosiery cotton, 100 % spun Polyester yarn and 2 blends of PC yarn with proportions of 20:80 and 35:65 respectively were used to knit fabrics. Care was taken that all the yarns to be used are nearly of same count i.e 30S or nearer to it.

2.2 Preparation of Fabric Samples

Double jersey interlock knitted fabrics were made from 100% cotton, 100% polyester and their blends. Above all yarns are knitted on a double jersey knitting machine and all machine parameters were kept constant for all samples. The details regarding knitting machine parameters are listed in Table 1

Table 1 - Machine Parameters of Knitting Machine

Machine Type	Double Jersey
Fabric Type	Interlock
Cylinder Diameter	30"
Gauge	24
Feeders	96
Needles	2268

2.3 Enzymatic Scouring

The double jersey fabrics knitted from cotton, polyester and their blends were cut to the half of their length and this half-length of fabrics were processed on winch dyeing machine. The enzymatic scouring was done in the bath with material to liquor ration of 1:20 and enzyme concentration 20%. The fabric was loaded into the bath at 200C and then the bath was heated to 50-650C for 60 min. No bleaching was carried out. The scoured fabrics were rinsed at 800C for 10 min,

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 7, Issue 12, December 2020

DOI 10.17148/IARJSET.2020.71202

twice at 600C for 10 min and cold washed at room temperature for 10 min. Samples were tested 'before relaxation' and 'after relaxation'

2.4 Yarn Testing

Yarn unevenness was measured on the Premier yarn Unevenness tester according to ASTM D1425 method. Yarn tenacity and breaking elongation were measured on a Premier Tensomax-7000 tester according to ASTM D2256 procedure. The results for the yarn properties are shown in Table 2.

Table 2 - Raw Material (Yarn) Properties

Test parameter	100 % cotton	PC 20:80	PC 35:65	100% Spun PET
Nominal count	30 Ne	30 Ne	30 Ne	172/48 d 32s Ne
Actual count	29.77	29.81	29.73	*
Count CV (%)	0.90	1.08	1.34	*
CSP	3022	3036	3067	*
U%	9.77	9.86	9.77	*
Thin places/km	0.3	0.5	1	*
Thick places/km	20.8	20.8	45	*
Neps/km	35	37.8	110	*
Total imperfection/km	56.11	59.6	156	*
Hairiness H	6.36	6.44	7.08	*
TPI/Tm	20.04/3.66	19.71/3.60	18.62/3.4	*
RKm	19.94	21.29	23.44	1.22 cN/dtex
Elongation (%)	5.16	6.53	7.90	16.34

*- tests have not taken

2.5 Fabric Properties

After knitting, the fabrics were undergone wet relaxation for getting dimensional stability. The testing of knitted fabrics was carried out at standard atmosphere of 65% RH and 27 ±20C. All properties for the 100% cotton, PC 20:80, PC 35:65 and for 100 % polyester fabrics were tested.

2.5.1 Dimensional Properties of Fabrics

The wales and course densities were measured with a pick glass at 10 different randomly selected positions for each sample.

2.5.2 Stitch Length or Loop Length

The loop length was derived by unraveling 12 courses of equal length and their total length (LT) was measured. The average loop length was calculated using following formula.

Average length (Lav) = LT /12 (cm)

Loop length (l) (cm) = Lav / no. of wales in that unit length

2.5.3 Tightness Factor

The tightness factor (TF) of the knitted fabric was determined by following formula

$TF = \sqrt{Tex} / l$

Where, l – Loop length (cm)

Due to wet relaxation treatment, internal stresses developed in fabric during manufacturing were removed. Hence, fabric gets shrunk dimensionally and became tight.

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 7, Issue 12, December 2020

DOI 10.17148/IARJSET.2020.71202

2.5.4 Thickness (cm)

Thickness is the distance between two opposite surfaces of the fabric. Thickness of the knitted fabric made form cotton, polyester and their blends was measured with thickness tester as per ASTM D 1777.

2.5.6 Areal Density (g/m2)

Areal density is the weight per unit area of knitted fabric expressed in gm/m2. Areal density was measured with GSM cutter and then the samples were weighed on electronic balance as per ASTM D3776.

3. RESULTS AND DISCUSSION

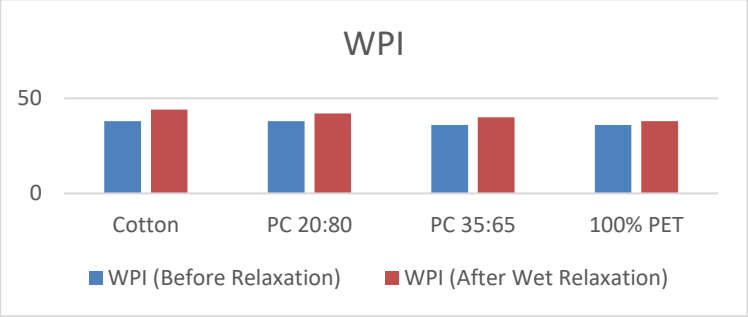
3.1 Wales per Inch

The Table 3 shows the results of the change in wale density before and after the relaxation for the different fabrics. As seen from the table, it is found that the wet relaxation of the fabric increases the wale density increasing the density of the fabric

Table 3 – Effect on Wale density

Sample/Wales per inch	WPI (Before Relaxation)	WPI (After Wet Relaxation)
Cotton	38	44
PC 20:80	38	42
PC 35:65	36	40
100% PET	36	38

Fig. 1 Effect on Wale Density



3.2 Courses per Inch

The Table 4 shows the results of the change in course density before and after the relaxation for the different fabrics. As seen from the table, it is found that the wet relaxation of the fabric increases the course density also increasing the density of the fabric. But the change in the courses per inch is less affected as compared to wales. The width of the fabric after wet relaxation is more affected than the length

Table 4 - Effect on Course density

Sample/Courses per inch	CPI (Before Relaxation)	CPI (After Wet Relaxation)
Cotton	64	68
PC 20:80	64	68
PC 35:65	64	68
100% PET	64	64

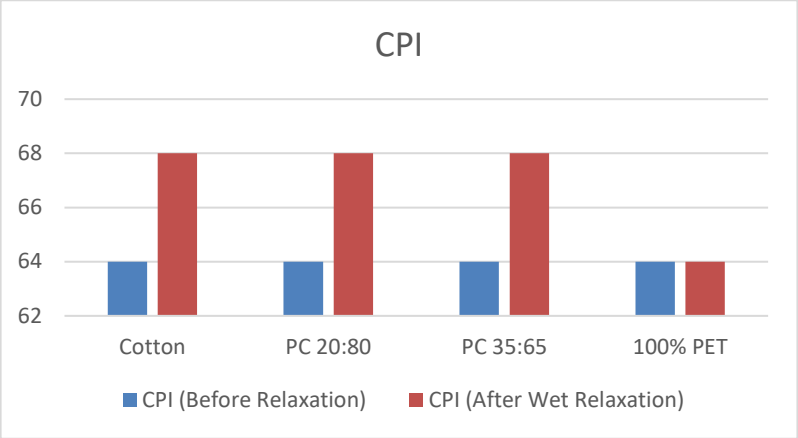
Fig. 2 Effect on Course Density

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
Vol. 7, Issue 12, December 2020

DOI 10.17148/IARJSET.2020.71202



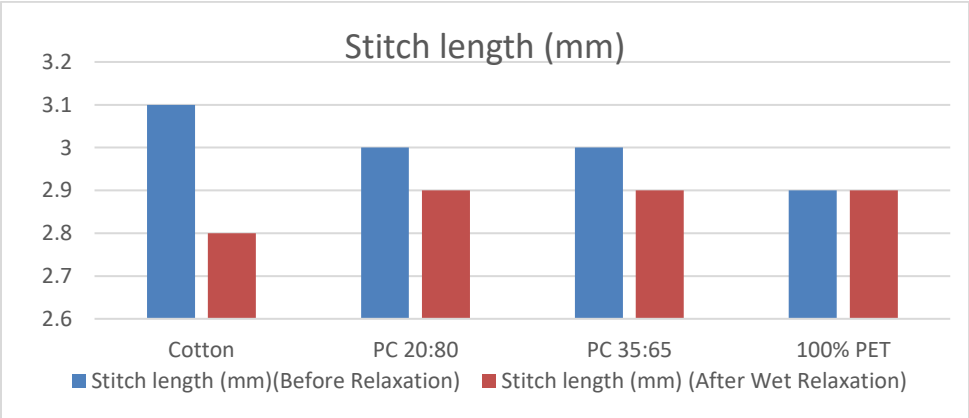
3.3 Stitch Length

The Table 5 shows the results of the change in stitch length before and after the relaxation for the different fabrics. As seen from the table, it is found that the wet relaxation of the fabric decreases the stitch length also increasing the density of the fabric. The change in the stitch length after relaxation is found more in 100% cotton and least in the 100% PET

Table 5 – Effect on Stitch length

Sample/Stitch length	Stitch length (mm) (Before Relaxation)	Stitch length (mm) (After Wet Relaxation)
Cotton	3.10	2.80
PC 20:80	3.00	2.90
PC 35:65	3.00	2.90
100% PET	2.90	2.90

Fig. 3 Effect on Stitch Length



3.4 Fabric Thickness

The Table 6 shows the results of the change in fabric thickness before and after the relaxation for the different fabrics. As seen from the table, it is found that the wet relaxation of the fabric increases the fabric thickness also increasing the density of the fabric.

Table 6 – Effect on Fabric Thickness

Sample/Fabric Thickness	**Thickness (mm) (Before Relaxation)**	**Thickness (mm) (After Wet Relaxation)**
Cotton	0.86	0.93
PC 20:80	0.86	0.97
PC 35:65	0.80	0.94
100% PET	0.78	0.90

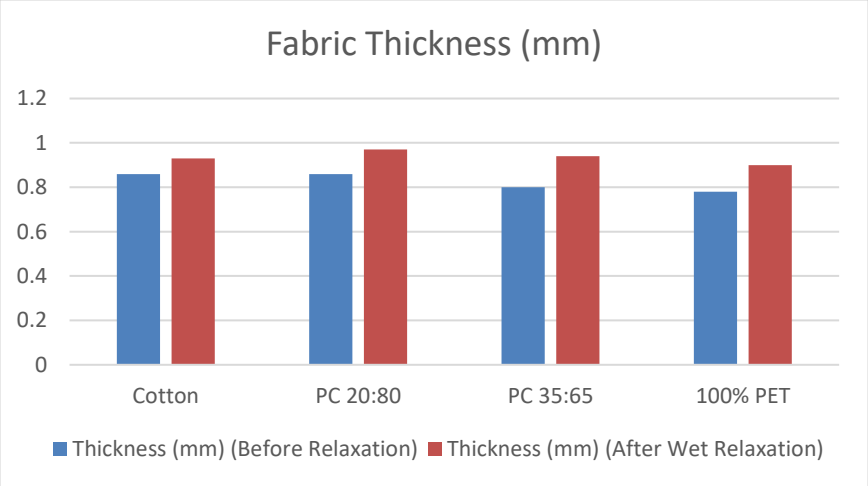
IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
Vol. 7, Issue 12, December 2020

DOI 10.17148/IARJSET.2020.71202

Fig. 4 Effect on Fabric Thickness



Presence of protruding fibers on yarn surface prevent close contact between yarns cross-over, results in poor packing of cotton yarn which gives rise to comparatively thicker fabric. Sudden increase in thickness is a result of poor packing due to improper blending. Though there is no any particular trend observed, the blend ratio and relaxation treatment has shown significant effect on the thickness of knitted fabrics. This may be due to the differences in the respective fiber diameter and blending.

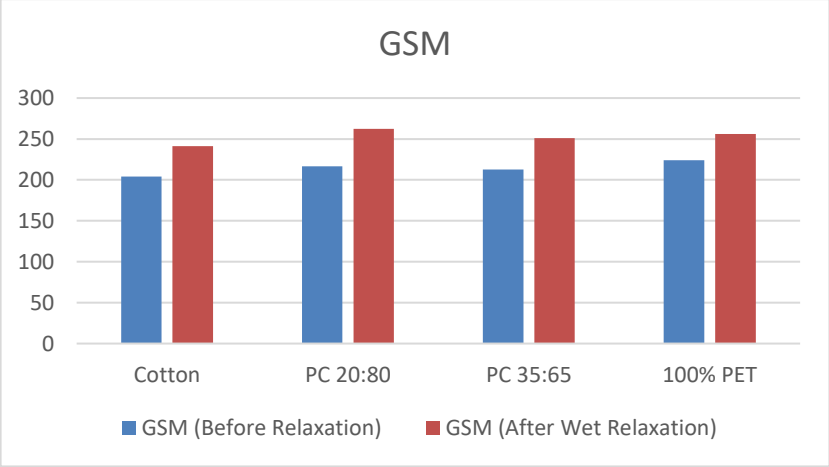
3.5 Areal Density (gsm)

The Table 7 shows the results of the change in areal density before and after the relaxation for the different fabrics. With the incorporation of polyester fiber %, the GSM of the knitted fabrics is assumed to increase due to increase in the % of finer fibers with high modulus. After relaxation treatment, the fabric gets shrunk and become tight and compact hence areal density of fabric increases. As shown in table, though no any particular trend is observed, statistical analysis shows that effect of blend ratio and relaxation treatment has significant effect on areal density of the fabric.

Table 7 – Effect on Fabric Areal Density

Sample/GSM	GSM (Before Relaxation)	GSM (After Wet Relaxation)
Cotton	203.96	241.20
PC 20:80	216.62	262.20
PC 35:65	212.56	251.20
100% PET	224.00	256.00

Fig. 5 Effect on Areal Density



IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 7, Issue 12, December 2020

DOI 10.17148/IARJSET.2020.71202

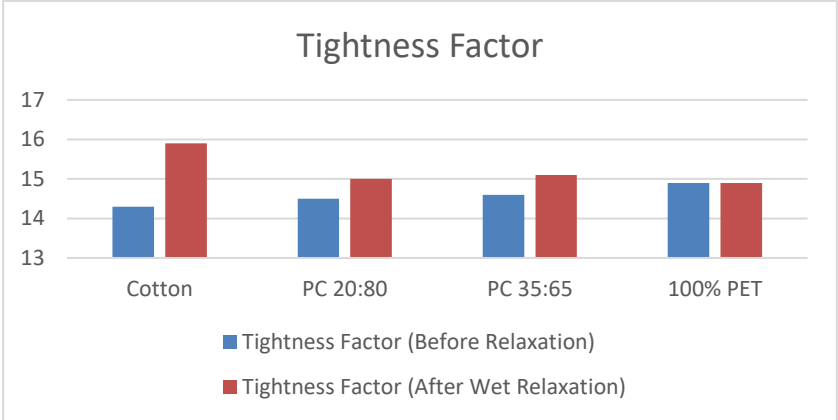
3.6 Tightness Factor

The Table 8 shows the results of the change in fabric tightness factor before and after the relaxation for the different fabrics. Tightness factor is reflected due to the stitch length and yarn count. As seen from the table, it is found that the wet relaxation of the fabric increases the tightness factor due to change in the stitch length

Table 8 – Effect on Tightness Factor

Sample/Tightness Factor	Tightness Factor (Before Relaxation)	Tightness Factor (After Wet Relaxation)
Cotton	14.3	15.9
PC 20:80	14.5	15.0
PC 35:65	14.6	15.1
100% PET	14.9	14.9

Fig. 6 Effect on Tightness Factor



4. CONCLUSION

1. Wale density is more affected than the course density after relaxation of the weft knitted fabric.
2. Fabric properties after wet relaxation are more significantly affected in the cotton yarn than the polyester yarn & its blends because of its hygroscopic nature.
3. Knitted fabric thickness increases due to relaxation process as the length and the width of the fabric gets shrunk.
4. The areal density and the tightness factors increase significantly after relaxation of the fabric.

REFERENCES

[1]. Wu, H. Y., Zhang, W., Li, J. 'Study On Improving The Thermal-Wet Comfort Of Clothing During Exercise With An Assembly Of Fabrics', Fibers & Textiles in Eastern Europe 75 (4) 2009: pp. 46 – 51.
[2]. Oglakcioglu, N., Marmarali, A., '*Thermal Comfort Properties of some Knitted Structures',* Fibers & Textiles in Eastern Europe 64 (5) 2007: pp. 94 – 96.
[3]. H.N.Yoon, A. Buckley, 'Improved Comfort Polyester: Part I: Transport Properties and Thermal Comfort Of Polyester/Cotton Blend Fabrics', Text. Res. J1984, 54 :289-298
[4]. Mikučionienė, D., Čiukas, R., Mickevičienė, A. '*The Influence of Knitting Structure on Mechanical Properties of Weft Knitted Fabrics',* Materials Science (Medžiagotyra) 16 (3) 2010: pp. 221 – 225.
[5]. N. Mao and S.J. Russell, 'The Thermal Insulation Properties of Spacer Fabrics with a Mechanically Integrated Wool Fiber Surface', Textile Research Journal December 2007 77: 914-922,
[6]. B.V. Holcombe and B.N. Hoschke, '*Dry Heat Transfer Characteristics of Underwear Fabrics',*Textile Research Journal June 1983 53: 368-374
[7]. NurayUcar, Turgut Yilmaz, *'Thermal Properties Of 1*1, 2*2,3*3 Rib Knitted Fabrics'* Fibers and Textile in Eastern Europe 2004,July/Oct ,12(3): 34-38