International Journal of Academic Research and Development
ISSN: 2455-4197
Impact Factor: RJIF 5.22
www.academicsjournal.com
Volume 3; Issue 2; March 2018; Page No. 218-221

A study on regenerated cellulosic fabrics and its comfort properties

R Divya[1], G Manonmani[2], M Jayakumari[3]

[1]Assistant Professor, Department of Costume Design & Fashion, PSG College of Arts and Science, Coimbatore, Tamil Nadu, India
[2]Assistant Professor, Department of Home Science, Mother Teresa University, Kodaikanal, Coimbatore, Tamil Nadu, India
[3]Assistant Professor, Department of Textiles and Apparel Design, Bharathiar University, Coimbatore, Tamil Nadu, India

Abstract

Ample numbers of research works are available on cotton knit fabric structures. Because, many researchers already examined and reported their findings about the natural cellulose cotton knit structures with respect to their geometric, mechanical, dimensional, and comfort properties. Comparatively, the research works carried out on regenerated cellulose knit structures are less. Hence, an effort is made through the researchers of this work to examine the geometric properties for a range of regenerated cellulose tubular single jersey knit fabric structures knitted with uniform machine parameters in this paper. For the proposed work, four types of regenerated cellulose hosiery yarns are procured namely, viscose, modal, tencel and bamboo with similar linear density 19.68 tex (equivalent to 30^s Ne count). From the above each yarn four tubular knitted fabric structures are knitted namely plain, cross tuck, cross miss and twill in the same circular multi cam track single jersey knitting machines with uniform stitch length. Out of these four fabric structures plain is an all knit loop structure, cross tuck is a structure with knit and tuck loop combination, cross miss is a structure with knit and miss and the twill structure is produced with the combination of knit, tuck and miss loops. In total sixteen samples are produced and their basic properties such as wale density, course density, stitch density, areal density, stitch length, thickness are estimated discusses. All the geometric property results are recorded properly and the fully relexaed state is discussed in detail in this part one.

Keywords: regenerated cellulose yarn, stitch length, single jersey, cross tuck, cross miss, and twill

Introduction

Chandrasekhar *et al* (1995) [1] stated that weft knitting is the more diverse, widely spread and larger of two sectors, and accounts for approximately one quarter of the total production of apparel fabric compared with about one sixth for warp knitting. Ajgaonkar (1998) [2] explained that the smallest element of a knitted fabric is the loop. During knitting the loop is extended due to take down force applied to the fabric. It is not possible to discuss the geometric and other properties of knitted fabrics without describing the elements of a knitted structure. Doyle (1953) [3] expressed that the knitted loop and the length of yarn knitted into loop, is an important parameter for the measurement of knitted fabric quality. The loop has a constant length (ℓ) which is the length of yarn needed to form a loop. Anbumani (2006) [4] described that plain is the simplest fabric construction all units are of the same sort, i.e. each loop is in the same shape and is pulled through the previously knitted loop in the same manner or direction. Ajgaonkar (1998) [2] stated that in a knitted structure, apart from the plain stitch, other types of stitches may also be produced by varying the timing of the intermeshing sequence of the old and new loops. The most commonly produced stitches are the tuck stitch and miss stitch. Two or more miss stitches in sequence is called float. Plain derivative structures such as pique, double pique, popcorn, Lacoste and cross tuck are better examples for knit and tuck stitch combination, cross miss is for knit and miss stitch combination, twill is for knit, tuck and miss stitch combination are the interesting outcome of these two fundamental derivative stitches of weft knitting. Munden (1959) [5, 6] first expressed the use of a constant factor to indicate the relative tightness or looseness of a plain knit structure called tightness factor represented by ‘K’. Knapton *et al* (1968) [7] claimed that most spun yarn single knit fabric is commercially knitted between the range of $9 < K < 19$. It is essentially impossible on any machine gauge or with any yarn count to knit fabric over a wider K range. A more usual knitting range, from loose to tight fabric is $12 < K < 18$ with a mean value of 15. Peirce (1947) [8] ried to generalize a loop model for a plain knit structure (i.e.) a three-dimensional model of a plain-stitch loop. An attempt was made by Chamberlain (1949) [9] to create a model for the plain-knitted structure, who established a theoretically balanced loop. Leaf and Glaskin (1955) [10] criticized Peirce (1947) [7] model. They showed that, in reality, Peirce (1947) [7] model could not represent a stable fabric. Doyle[3] (1953) [3] had observed, when investigating the dimensional properties of plain-knitted fabrics, that for a wide range of fabrics, the product of the number of courses and wales in unit area is dependent solely upon loop length. A study by Munden *et al* (1963) [11] showed that the dimensions of plain knitted wool fabrics, in a state of minimum energy, were dependent only upon the length of yarn knitted into each loop. His experimental studies indicated that courses per unit length, wales per unit length and loop length must be related to each other by constants. They showed that there is only one factor which governs the dimensions of a knitted fabric known as loop length or stitch length. It means the length of the yarn knitted in to a loop. Nutting and Leaf (1964) [12] shown experimentally that the geometry (i.e., the loop shape) of weft knitted fabrics is controlled by loop length, fibre type and properties, and method of relaxation. Postle (1965, 1968) [13, 14] found that the dimensional changes of plain-knitted fabrics brought about by various relaxation treatments. A wet treatment at an elevated temperature led to complete relaxation of all the hydrophilic fabrics investigated and made their loop shape similar. Knapton *et al* (1968) [7] examined the dimensional properties of knitted wool fabrics and claimed that only in the fully relaxed state the plain knitted structure is a reasonably stable structure; and in any other state, the nature of the knitted loop is dependent on the yarn's physical properties, mechanical processing and knitting variables. Song and Turner (1968) [15] displayed the value of stitch density varies with the tightness factor for dry relaxed fabrics, however, as progressively more severe wet-relaxation treatments were applied, stitch density became independent of the tightness of construction. Schwartz *et al* (1982) [16] concluded that the tuck loop reduces fabric length and length-wise elasticity. It provides greater stability and shape retention to the knit fabric structure. It increases fabric width and width wise extensibility by pulling the held loops downwards, causing them to spread outwards. It makes the fabric more bulky and increases the areal density (GSM) of the fabric. Miss stitch makes fabrics narrower by pulling the wales closer together, thus reducing widthwise elasticity and improving fabric stability. It makes the fabric flimsy one and reduces the areal density (GSM) of the fabric. Kumar *et al*[17,18] (2013, 2014) investigated the suitability of cotton sheath elastomeric core spun yarn for circular knitting as an alternative for bare spandex feeding and the effect of loop length variables on the geometric properties of single jersey and double pique fabrics under different relaxation states. They reported that the course density, stitch density and areal density have significant increase between their fabric relaxation states.

This part of the work presented in this paper deals with geomentric properties of various regenerated cellulose hosiery yarn made weft knit structures. The said fabric properties are measured in their fully relaxed states and compared by taking the entire above researcher's outcome as thumb rule. This comparison has helped us to understand the effect of tuck and miss stitches over the geometric properties of the observed knit fabric samples

Experimental materials and methodology

The materials used, production methodologies fabric samples, sample preparation for relaxation and testing and test procedures are discussed elaborately under this title.

Procurement of hosiery yarns

Commercially available regenerated cellulose hosiery yarns such as viscose, modal, with nominal count 19.68 Tex are procured for the development of fabric samples of this research work.

Knitting of fabric samples

The procured four types of hosiery yarns are knitted into four different fabric samples namely plain, cross tuck, cross miss and twill with the help of a multi cam track circular jersey knitting machine as specified in the Table 2.2 with uniform stitch length. The fabric samples were developed as per the fabric sample plan given in Table 1.

Fully relaxed state

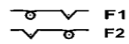
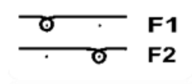
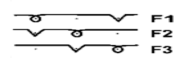
Wet relaxed samples were washed thoroughly, briefly hydro-extracted for 1 minute and tumble dried for 60 minutes around 70 °C. Samples were then laid on a flat surface in a conditioning cabinet of 21 °C ± 1 at a relative humidity of 65 % ± 2 for 48 hours, free of tension. All the relaxation treatments were carried out according to the ASTM D 1284-76.

After dry relaxation the changes occurred in the geometric properties of the fabric samples such as wale density, course density, stitch density, areal density are observed and recorded and their respective constants such as Kw, Kc, Ks, and Kc/Kw are also calculated and noted down. All the relaxation treatments are carried out as per ASTM D 1284-76 test procedure.

Table 1: Circular knitting machine particulars

Sl. No.	Machine Specification	
1.	Type of knitting machine	Circular
2.	Type of knitting	Weft knitting
3.	Make	Falmac, Singapore.
4.	Diameter	20”
5.	Gauge	24 E
6.	No of feeders	60
7.	Feeder type	Positive storage feeder
8.	No. of needles	1800
9.	No. of cam tracks	4

Table 2: Fabric sample plan

Sl. No.	Fabric	Structure	Code	Symbolic representation	Stitch length in cm	Tightness factor (K)
1.	Viscose	Plain	VPL		0.30	14.79
2.	Modal		MPL			
3.	Tencel		TPL			
4.	Bamboo		BPL			
5.	Viscose	Cross tuck	VCT			
6.	Modal		MCT			
7.	Tencel		TCT			
8.	Bamboo		BCT			
9.	Viscose	Cross miss	VCM			
10.	Modal		MCM			
11.	Tencel		TCM			
12.	Bamboo		BCM			
13.	Viscose	Twill	VTW			
14.	Modal		MTW			
15.	Tencel		TTW			
16.	Bamboo		BTW			

V – Viscose, M – Modal, T – Tencel, B – Bamboo, PL – Plain jersey, CT – Cross Tuck, CM – Cross Miss, TW - Twill

Testing procedure of geometric properties of knitted fabrics

The estimation of geometric properties of knitted fabrics such as wale density and course density (ASTM D 3887: 1996 (RA 2008)), loop length (ASTM D 3887), areal density (ASTM D 3776) and thickness (ASTM D 1777-07) of the samples are carried out for all the specimens in both DRS WRS &FRS and here in the paper FRS is discussed.

For the measurement of wale density and course density 1" X 1" square is marked on the samples in 10 different places apiece. After that the wale density is counted with maximum attention with the help of a counting glass in all the 10 places of all the samples and noted. After that, the mean value of wale density is estimated for each sample. In plain jersey sample, the course density is measured carefully by using a thread magnifying glass in all the 10 places and noted. Afterwards, the mean value of them is estimated. But, the cross tuck, cross miss and twill fabric samples the courses are found with the combination of knit and tuck, knit and miss and knit, tuck and miss stitches and hence direct counting of course density will not give accurate results. So, 10 marked samples from these fabric samples are cut and untraveled course wise to estimate the course density and it's mean.

The stitch length is measured from unravelling 10 courses each with 100 wales (adjacent loops) and the total length of each course is measured after smoothly straightening the course. The average stitch length is calculated by using the simple formula i.e. total length of 100 wales in cm /100 to obtain the length of one loop in cm from a course. The same way the loop length is obtained for all the ten courses and the mean value is calculated for every sample.

The areal density of the knitted fabrics is measured by cutting the sample with area of 100 cm^2 by using a standard circu-cutter. The cut sample is weighed in the electronic balance and the resultant value is multiplied by 100 to get the areal density in GSM. Thus 10 specimens are cut from each sample and the mean value is calculated.

Thickness is measured in 10 different places of every specimen and noted down. From that the mean is calculated for further analysis.

Result and Discussion

Physical Properties

Tinsel

Table 3: Testing Result

	TCM	TCT	TTW	TSJ
WPI	26	24	20	32
CPI	32	50	34	44
GSM	127	151	132	137
Thickness	0.56	0.70	0.70	0.45
Loop length	0.3	0.3	0.3	0.3
Bursting strength	9	9	8	9

Thus from the above Table the physical properties of Tencel Cross Miss, Tencel Cross Tuck, Tencel Single Jersey, Tencel Twill was discussed.

Fully Relaxed State

Tencel

Table 4: Washing Test

wash		TCM	TCT	TTW	TSJ
I	Length%	4.4%	1.5%	2.8%	2.8%
	Width%	4.8%	4.2%	6.2%	8.2%
II	Length%	5.5%	3.0%	1.5%	1.8%
	Width%	4.8%	1.2%	1.8%	1.0%
III	Length%	6.5%	1.2%	1.2%	1.8%
	Width%	4.0%	2.5%	1.6%	3.2%
IV	Length%	6.5%	2.5%	1.5%	2.8%
	Width%	5.8%	1.5%	5.2%	1.2%
V	Length%	4.2%	1.8%	1.5%	3.1%
	Width%	3.5%	1.0%	2.2%	1.0%

Thus from the above Table the washing test of fully relaxed state of Tencel Cross Miss, Tencel Cross Tuck, Tencel Single Jersey, Tencel Twill was discussed.

Bamboo

Table 5: Washing Test

Wash		BCM	BSJ	BCT	BTW
I	Length%	2.8%	1.6%	1.0%	1.1%
	Width%	1.0%	2.2%	1.2%	7.2%
II	Length%	2.2%	1.2%	1.0%	1.2%
	Width%	1.8%	3.1%	1.1%	6.8%
III	Length%	2.0%	2.5%	1.0%	1.2%
	Width%	1.2%	3.1%	2.1%	7.2%
IV	Length%	1.1%	1.3%	1.1%	1.2%
	Width%	1.3%	2.1%	1.2%	6.5%
	Length%	1.0%	1.0%	1.0%	1.9%
	Width%	1.5%	2.1%	1.2%	5.2%

Thus from the above Table the washing test of fully relaxed state of Bamboo Cross Miss, Bamboo Cross Tuck, Bamboo Single Jersey, Bamboo Twill was discussed.

Bamboo

Table 6: Testing Result

	BCM	BSJ	BCT	BTW
WPI	24	32	24	22
CPI	36	50	40	36
GSM	133	148	164	138
Thickness	0.72	0.53	0.72	0.66
Loop length	0.3	0.2	0.3	0.3
Bursting strength	7	7	7	7

Thus from the above Table the Testing result of fully relaxed state of Bamboo Cross Miss, Bamboo Cross Tuck, Bamboo Single Jersey,Bamboo Twill was discussed.

Table 6: Bamboo

	BCM	BSJ	BCT	BTW
WPI	24	32	24	22
CPI	36	50	40	36
GSM	133	148	164	138
Thickness	0.72	0.53	0.72	0.66
Loop length	0.3	0.2	0.3	0.3
Bursting strength	7	7	7	7

Thus from the above Table the Physical properties of Bamboo Cross Miss, Bamboo Cross Tuck, Bamboo Single Jersey, Bamboo Twill was discussed.

References

1. Chaudhari SS, Chitnis RS, Ramakrishnan R. Waterproof Breathable Active Sports Wear Fabrics, 2013, http://www.sasmira.org/sportwear.pdf
2. Crawshaw JME, Briggs NP, Heenan RK, Cameron RE. The Hydration of Tencel Cellulose Fibres Studied Using Contrast Variation in Small Angle Neutron Scattering, Polymer. 41; 5:1873-1881.
3. Demiroz A, Gun Unal C, Unal1 BT. Dimensional and Physical Properties of Plain Knitted Fabrics Made from 50/50 Bamboo/cotton Blended Yarns, Fibers and Polymers, 588-592. 1019 2014 Beltwide Cotton Conferences, New Orleans, LA, January2008-2004; 9(5):6-8.
4. Dziworska G, Frydrych I, Matusiak M, Filipowska B. Aesthetic and hygienic properties of fabrics made from different cellulose raw materials, Fibres Text East Eur. 2000; 8(2):46-49.
5. Eichinger D, Bartsch P, Schafheitle P, Kreuzwieser C. Wearer comfort properties of Lenzing Lyocell, ITB Int Text Bull. 1999; 45(3):58-60.
6. Erdumlu Nazan, Ozipek Bulent. Investigation of Regenerated Bamboo Fibre and Yarn Characteristics, FIBRES & TEXTILES in Eastern Europe. 2008; 4(69):43-47.
7. Ibbett RN, Hsieh YL. Effect of fibre swelling on the structure of Lyocell fabrics, Text Res J. 2001; 71(2):164-173.
8. Morgado J, Cavaco-Paulo A, Rousselle MA. Enzymatic treatment of Lyocell-clarification of depilling mechanisms, Text Res J. 2000; 70(8):696-699.
9. Nergis BU, İridağ Y. Lyocell Fibre and Its Properties (Lyocell Lifi ve Özellikleri), Tekstil ve Teknik. 2000; 16 (2):74-84.