IOSR Journal of Polymer and Textile Engineering (IOSR-JPTE)
e-ISSN: 2348-019X, p-ISSN: 2348-0181, Volume 5, Issue 5 (Sep. - Oct. 2018), PP 21-24
www.iosrjournals.org

Effect of Yarn Count on Single Jersey Knitted Fabric Properties

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Abstract: *In this study variations of knitted fabrics properties due to different yarn count was analyzed. Here weft knitted fabrics like single jersey were used. Yarn count and GSM of fabric has great impact on fabric properties. Aim of this project is to find out the convenient strategies to choose yarn count selection, GSM selection to get the desired qualities in the single jersey grey fabrics. In this research, Knit fabrics(made from 100% cotton yarn and blended yarn) having different GSM were tested where 26 Ne,30 Ne 100% cotton yarns and 26 Ne blended yarns were used for manufacturing single jersey fabrics.*

Key words: *Fibre, Yarn, GSM, Yarn count, Stiffness, Tear strength.*

Date of Submission: 01-10-2018 Date of acceptance: 16-10-2018

I. Introduction

Fiber or fibre is a natural or synthetic substance that is significantly longer than it is wide. A textile fiber is a long thin object with a high ratio of length to thickness. It is characterized by a high degree of fineness and outstanding flexibility. In addition, it should have dimensional and thermal stability and minimum levels of strength and extensibility consistent with the end use[2].

A yarn is defined as "an assembly, of substantial length and relatively small cross-section, of fibres or filaments, with or without twist". Yarn is the fundamental unit of fabric. Yarn contains a lot of properties (variables) which can affect on knitted fabric finished qualities. The constructional properties of a weft knitted fabric depends on stitch length and yarn count. Yarns are the raw materials manipulated during knitting [3].An experienced knitter will describe many yarn properties and knitting variables, all of which, from his experience, affect the characteristics of knitted fabrics. Any of these properties, he may find it necessary to adjust or control in order to obtain a finished fabric of the required physical properties[6]. The main yarn properties are yarn count and yarn twist[1]. Yarn Count is the numerical expression of fineness. According to "Textile Institute" the number indicating the mass per unit length or length per unit mass of yarn is called count [1]. Generally combed yarn strength is higher than carded yarn of the same count[4]. Yarn twist is the spiral turns given to the yarn in order to hold constituent fibres threads together. An increase in the amount of twist produces an increase in the yarn strength, if yarn strength is increase, the fabric strength will be increased [1]. Normally combed yarns are stronger, less hairy, more uniform and more lustrous than carded yarns [5].

There are three principle methods of mechanically manipulating yarn into textile fabrics : interlacing, intertwining, interloping. Knitting is a process of manufacturing a fabric by interlooping of yarns[1]. Knitting is a technique for producing a two dimensional fabric made from a one-dimensional yarn or thread. Knitted fabrics are divided into two major groups, weft & warp knitted fabric. Weft knitted fabrics can be produced in circular or flat knitting machine. The basic element of a knit fabric structure is the loop intermeshed with the loops adjacent to it on both side and above and below it. Knitting is the second most important method of fabric formation. Knit fabric strength depends upon yarn strength and stitch length. Manufacturing of knitted fabrics involves intermeshing of yarn loops where one loop is drawn through another loop to form a stitch. Because of difference of both sides of single jersey knit fabric & side (Face or back) of the single jersey always tends to create curling.

The primary knitting elements of circular knitting machines are needle, cam, and sinker. The rising demand on knitted garments all over the world motivate the researcher to research about various knitted fabric, production processes, developing new structures[8]. Knitting machines comprise a needle holder that supports a plurality of needles, which are arranged side by side and can be actuated with an alternating motion along their axis with respect to the needle holder in order to form knitting. There was problem in our industries to produce

knitted fabric of required GSM. In the circular knitting machine with a great number of knitting needles, when the number of needle increases, the distances between the needles or sinkers have to be shrunk. Different count yarns produce different knit fabric. The properties of knit fabric are changing with change of count of the yarn by keeping the parameters of knitting machine (dia, gauge, stitch length) same in every case. Properties of knitted fabric like GSM, Stiffness, Tear strength, Tensile strength etc. are showing different value in different count yarn .In this paper changing of values with the changing of count of yarn were observed. Here, two different counts of yarns were used

Fabric quality means different properties of finished fabric which depends on yarn properties and fabrics construction. A knitted fabric quality is depended on the fabric properties. The properties which are important for knitted fabric and maintained in the industries from grey stage to finished stage are GSM, Stiffness, tearing strength, tensile strength etc.

A high level of elasticity and recovery is being possessed by knitted fabric for unique properties. A good quality knitted fabric has some good properties, ex- , tearing strength, stiffness and average tensile strength etc. And these properties are varied by different yarn counts and GSM. In this study variation of three properties of knitted fabrics due to different yarn count and GSM are considered.

II. Materials & Methods

2.1. Materials In this research work, the following materials are used to evaluate the properties of weft knitted fabrics.

- Single Jersey Fabric (made with 26 Ne and 30 Ne yarn of 100% cotton).
- Single Jersey Fabric (made with 26 Ne blended yarn).

III. Methods

3.1. Yarn Selection : As per the experiment the variation of properties of knitted fabric due to different count of yarn such as 26/1, 30/1 Ne were used to produce weft knitted structures like—Single Jersey.

3.2. Determination of Fabric Weight (GSM) After relaxation & conditioning of knit fabric samples, GSM of samples were tested by taking test samples with the help of GSM cutter & weighting balance (electronic) [7].

IV. Results and Discussions

4.1. Stiffness is the rigidity of an object — the extent to which it resists deformation in response to an applied force. It is the tendency of fabric to keep standing without any support. Bending stiffness characteristics of fabrics arise from the structure of the fabric itself as well as from the structure of the constituent yarns. Yarn (or fiber) diameter is the most important structural property of a fabric to affect its stiffness. As the fiber or yarn diameter is increased, the fabric stiffness increases. The stiffness of fabric was tested according to ASTM Standard – D4032.

4.1.1. Pneumatic Stiffness Test for 100% cotton yarn :

No. of observation	Count Ne	Stitch length	GSM Fabric type	Pneumatic Force (N)
01	26	2.82	160	0.1 N
02	26	2.80	165	0.2 N
03	30	2.78	140	0.1 N
04	30	2.50	165	0.3 N

Here we found more stiffness for higher yarn count(Ne) and GSM by keeping other parameters same.

4.1.2. Pneumatic Stiffness Test for blended yarn:

No of observation	Count Ne	Yarn Composition	Stitch length	GSM	Pneumatic Force (N)
01	26	CVC(60/40)	2.82	160	0.1
02	26	PVC(50/38/12)	2.80	160	0.2
03	26	GM(10%)	2.80	165	0.4
04	26	GM(10%)	2.86	160	0.1
05	26	GM(1%)	2.82	165	0.2

Here CVC (60/40) fabric and GM (10%) fabrics were taken and both of those fabrics had same yarn count 26 Ne and GSM 160.Both of the fabrics showed same stiffness. PVC (50/38/12) has more stiffness than CVC (60/40). GM (10%) has more stiffness than GM (1%).

4.2.**Tear strength** (or tear resistance) is a measure of how well a material can withstand the effects of tearing. Tear strength is the resistance of the fabric against tearing or force required to propagate the tear once it is initiated[7]. Tear strength of the single jersey grey fabrics relies on: GSM of the fabric, strength of yarn, CPI and WPI, fibres to manufacture yarn, Type of fabric. Generally by increasing the GSM more tearing strength of the fabric can be found. Yarn strength is directly related with the tearing strength of the fabric, consequences for the augmentation of yarn strength is the possibilities of getting more tear strength. If we compare tear strength of fabrics made from simple ring spun yarn or compact or filament yarns then less tear strength will be found in case of simple ring yarn .Usually more ends/inch and picks/inch give more tear strength in the fabrics. The spun yarn if used in fabric shows low tear strength as compared to the filament yarn. It is easy to tear the knitted fabric as compared with the woven one. The Tear strength of fabric was tested according to ASTM Standard – D1424.

4.2.1. Tearing strength test for fabrics made with 100% cotton yarn :

No. of observation	Count (Ne)	Stitch length	GSM	Test result (N)
1	26	2.82	160	26.4
2	26	2.80	165	26.7
3	30	2.78	140	10.3
4	30	2.50	165	26.2

Here we found more Tear strength for higher yarn count(Ne) and GSM by keeping other parameters same.

4.2.2. Tearing strength test for fabrics made with blended yarn:

No. of observation	Count (Ne)	Yarn composition	Stitch length	GSM	Test result (N)
1	26	CVC(60/40)	2.82	160	30.2
2	26	GM(10%)	2.80	165	26.3
3	26	PVC(50/38/12)	2.80	160	28.2
4	26	GM(1%)	2.80	165	24.2
5	26	GM(10%)	2.86	160	24.0

Here CVC (60/40) fabric had shown more tearing strength than PVC (50/38/12) fabric. CVC (60/40) fabric had shown more tearing strength than GM (10%) fabric.

4.3. Tensile strength is one of the most important mechanical properties for fabrics. Tensile strength is the ability of a material to withstand a pulling (tensile) force. The tensile strength of a fabric is the maximum amount of tensile stress that it can take before failure, such as breaking or permanent deformation. The resistance of a material to longitudinal stress, measured by the minimum amount of longitudinal stress required to rupture the material. The tensile strength of fabric was tested according to ASTM Standard E - 4. Here UTM (Testometric) was used to calculate the tear strength of the fabric.

4.3.1. Tensile strength test with UTM for fabrics made with 100% cotton yarn :

No of observation	Count Ne	Yarn composition	GSM	Elongation (mm)	Force N
01	26	100% cotton	160	218.5	595.6
02	26	100% cotton	165	192.9	550.7
03	30	100% cotton	140	194.2	337.5
04	30	100% cotton	165	282.1	640.2

4.3.2. Tensile strength test with UTM for fabrics made with blended yarn:

No of observation	Count Ne	Yarn Composition	GSM	Elongation (mm)	Force N
01	26	CVC(60/40)	160	190.22	591.0
2	26	PVC(50/38/12)	160	224.6	533.4
3	26	GM(1%)	165	219.1	635.2
4	26	GM(10%)	160	233.7	586.4
5	26	GM(10%)	165	203.6	382.2

Elongation of GM (10%) is higher than the elongation of CVC (60/40). Breaking force of GM (10%) is less than the breaking force of CVC (60/40). Elongation of PVC (50/38/12) is higher than the elongation of CVC (60/40). Breaking force of PVC (50/38/12) is less than the breaking force of CVC(60/40).

V. Conclusion

In case of finer yarn that means higher yarn count(Ne) and higher GSM give more stiffness , more tear strength , more breaking force in case of using 100% cotton yarn for single jersey weft knitted fabrics.
In case of blended yarn more tear strength, more stiffness and more breaking force were found . CVC (60/40) fabric and GM (10%) fabrics showed same stiffness. PVC (50/38/12) has more stiffness than CVC (60/40). GM (10%) showed more stiffness than GM (1%).By using blended yarn in single jersey weft knitted fabrics Elongation is decreasing with the increasing of GSM. This happened because GSM 160 fabric has less compact structure than the GSM 165 fabric. In less compact area the elongation is more than the more compact area due to force applied.

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