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Effect of Fabric Structures and Yarn Fineness on the Properties of Knitted Fabric.

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Abstract: *Knitted fabric structures greatly influence the dimensional and physical properties of the fabric. The main purpose of this work is to find out or investigate different rib fabric structures effect on the fabric properties such as Stitch length, Stitch density, GSM, Bursting strength, Tightness factor and Spirality. In this work 1×1Rib,2×1 rib, 2×2 rib were produced with 30/2 Ne and 34/2 Ne combed ring yarn on V-bed Flat knitting machine of 14 Gauge. The result of the tests are tabulated & graphically represented with respect to particular fabric properties. In addition, Wales per inch, Course per inch, Loop length, GSM, Spirality, Tightness factor, Burstingstrength of fabric were tested. According to test result, Wales per inch, Course per inch, GSM of 2×2Rib were higher than the 1×1 Rib and 2×1 Rib for both 30/2 Ne and 34/2 Ne. In addition WPI, CPI i.e. stitch density of 34/2 Ne is higher than 30/2 Ne but GSM of 34/2 Ne is lower than 30/2 Ne for different fabric structures.*

Keywords: *Knitted fabric structure, WPI, CPI, Stitch density, Loop length, GSM, Bursting Strength, Tightness factor, Spirality*

I. Introduction

The term knitting describes the technique of transforming continuous strands of yarn into a series of interlocking loops, each raw of such loops hanging from the one immediately preceding it [1]. Knitted fabrics are divided into two main groups, weft and warp knitted fabrics. Four primary structures –plain, rib, interlock and purl-are the base structures from which all weft knitted fabrics and garments are derived [2]. Knitted Structure of fabric is most important factor affecting fabric properties. Different structures show different value for wales per inch, course per inch, loop length, Spirality, GSM, Bursting strength, tightness factor if the same yarn and same machine setting are used. Besides, yarn count also affected the fabric properties.

Rib fabric:

Rib knit is a double-knit fabric that knits the fabric in vertical ridged pattern called ribbing and highly stretched in crosswise direction. The rib knit is a popular choice for everything from socks to sweaters. These fabrics are commonly used for tight T-shirts as they rib knits fits well than regular knits, undergarments and dresses.

II. Material And Methods

100% cotton yarn of 30/2 Ne and 34/2 Ne of 19 and 20 TPI were selected for this work. We produced rib structures on Flat V-bed knitting machine (14gauge, 40inchwidth). Here three rib fabrics 1×1 Rib, 2x1 rib 2x2 ribs we reproduced. On each sample the following test parameters were measured: Wales per inch, Courses per inch, Stitch density, Stitch length, Tightness factor, GSM, Bursting strength and Spirality. Method of test for cotton weft knitted fabrics relevant to the star fish process control package. Relaxation system, Number of Visible Course and Wales per cm, stitch density, stitch length, mass per unit area, cover factor, dimensional changes are measured in B.S. 1051, 1981;ISO 139,1937.

Material

1x1 rib: The simplest rib fabric is 1x1 rib. The first rib frame was invented by *JedediahStrutt*of Derby in 1755, who used a second set of needles to pick up and knit the sinker loops of the first set. It is now normally knitted with two sets of latch needles.

2x1 rib: 2x1 rib fabricis produced by needle set out either from front needle or back needle bed. 2x1 fabric can be produced by set out one alternate needle from front bed and no set out from back bed or vice versa.

2x2 rib: 2x2 rib fabric is produced by needle set-out from front and back needle bed. The fabric is produced by set out two alternate needles from both front and back beds.

III. Results and Discussion

Properties of some selected fabric structures named 1×1Rib,2×1 rib, 2×2 rib from 30/2 Ne and 34/2 Ne combed ring yarn are shown in Table 1 & Table 2.

Table 1: Knitted fabric properties for 30/2 Ne

Properties			
	1×1Rib	**2×1Rib**	**2×2Rib**
Wales per inch	34	30	38
Course per inch	21	24	26
Stitch density per inch²	714	720	988
Loop Length (mm)	5.83	5.24	5.58
GSM (gm/m²)	250	220	336
Bursting Strength (kg/cm²)	9.2	9.4	9.8
Spirility	1^0	5^0	1^0
Tightness factor	1.0763	1.1975	1.1245

Table 2: Knitted fabric properties for 34/2 Ne

Properties			
	1×1Rib	**2×1Rib**	**2×2Rib**
Wales per inch	36	32	40
Course per inch	22	26	28
Stitch Density per inch²	792	800	1120
Loop Length (mm)	5.3	4.86	5.1
GSM (gm/m²)	226	210	307
Bursting Strength (kg/cm²)	8	8.5	9.2
Spirility	1^0	6^0	1^0
Tightness Factor	1.1113	1.2119	1.1549

Wales per inch

A wale is a vertical column of loops produced by the same needle knitting at successive knitting cycles. The number of Wales determine the width of the fabric. WPI is highest for 2X2 rib and lowest for 2x1 rib both for 30/2 Ne and 34/2 Ne. Again, WPI is also increases with finer yarn count, i.e. higher for 34/2 Ne than 30/2 Ne yarn for all structures.

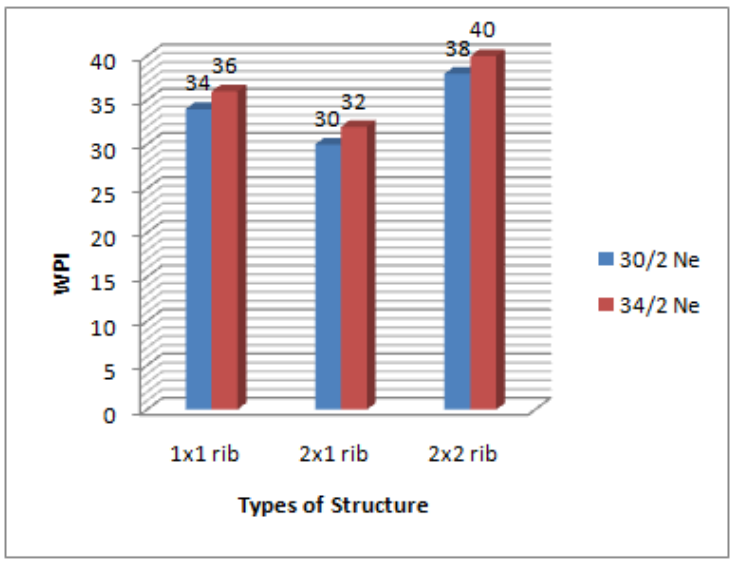

Figure 1: Effect of Fabric Structure and yarn count on WPI

Course Per Inch

Courses are rows of loops across the width of the fabric produced by adjacent needles during the same knitting cycle and the courses determine the length of the fabrics. CPI is highest for 2X2 rib and lowest for 1x1 rib both for 30/2 Ne and 34/2 Ne. Like as WPI, CPI also increases for finer yarn, i.e. higher for 34/2 Ne yarn than 30/2 Ne yarn for all structures.

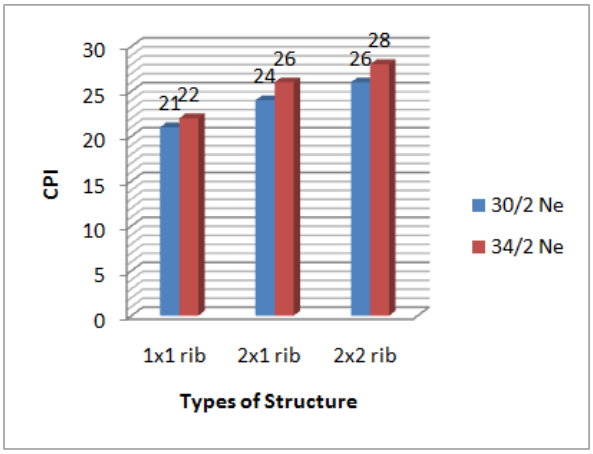

Figure 2: Effect of Fabric Structure and yarn count on CPI

Stich density

Stitch density is the product of WPI and CPI. Stitch density is highest for 2X2 rib both for 30/2 Ne and 34/2 Ne and lowest for 1x1 rib. Again, Stitch density is higher for 34/2 Ne yarn than 30/2 Ne yarn for all structures.

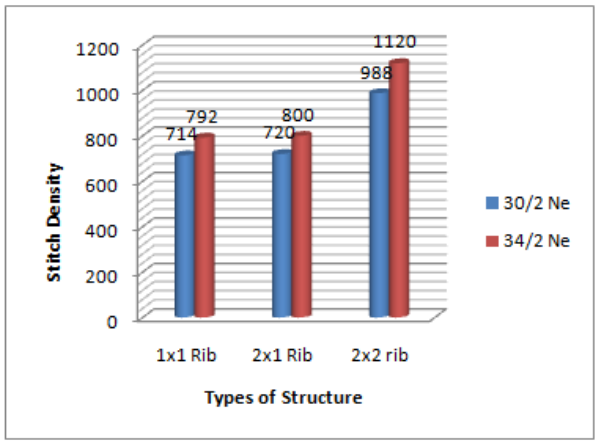

Figure 3: Effect of Fabric Structure and yarn count on Stitch density

Loop Length

Loop length is calculated by dividing thelength of a course by the total number of wales[4]. The loop length of 1x1 rib is highest and 2x1 rib is lowest both for 30/2 Ne and 34/2 Ne. But Loop length decreases with yarn fineness, i.e. lower for 34/2 Ne yarn than 30/2 Ne yarn for all structures.

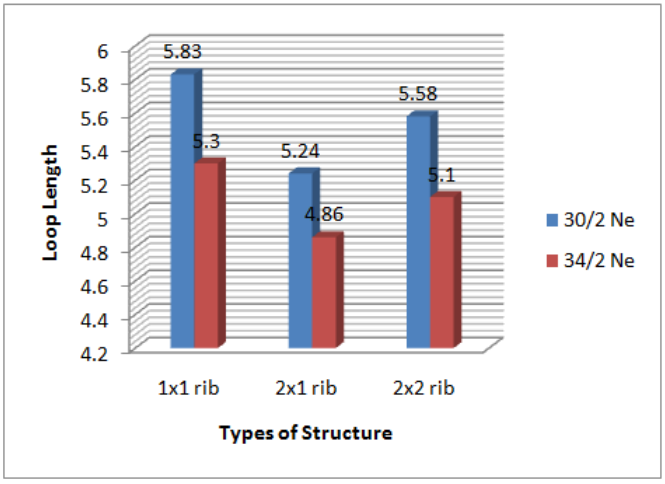

Figure 4: Effect of Fabric structure and yarn count on Loop length

Bursting Strength

Bursting strength is an alternative method of measuring strength in which the material is stressed in all directions at the same time and is therefore more suitable for such materials. Bursting strength of 2x2 rib fabric is higher for 30/2 Ne and 34/2 Ne.Like Loop length, Bursting Strength also decrease with yarn fineness, i.e. lower for 34/2 Ne yarn than 30/2 Ne yarn for all structures.

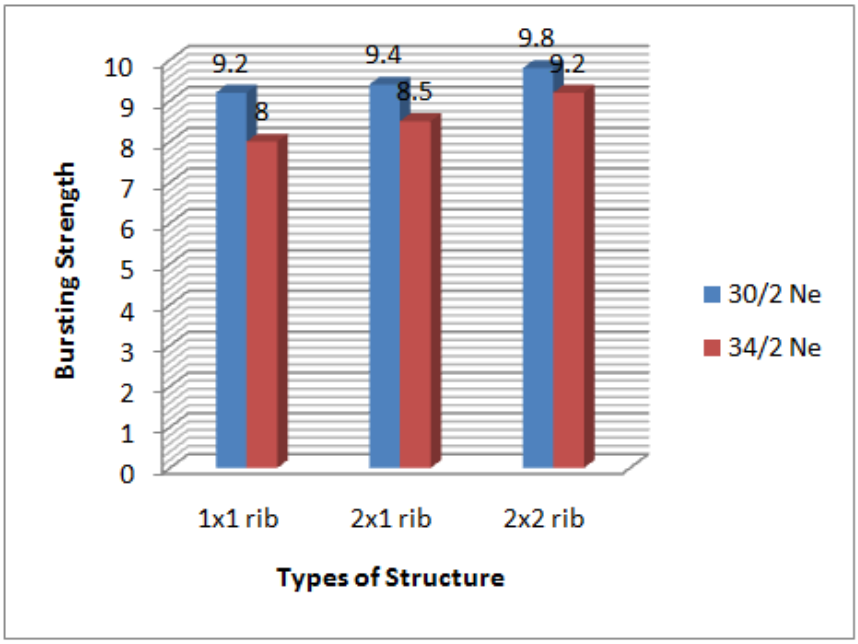

Figure 5: Effect of Fabric Structure and yarn count on Bursting strength

GSM

GSM means Gram per Square Meter. It is widely used to express the thickness of knit fabric. It can be defined as the weight of fabric in gram of one square meter of fabric. GSM of 2x2 rib fabric is highest and 2x1 rib is lowest both for 30/2 Ne and 34/2 Ne. Analogy with loop length and Bursting strength, GSM decreases with yarn fineness, i.e. lower for 34/2 Ne yarn than 30/2 Ne yarn for all structures.

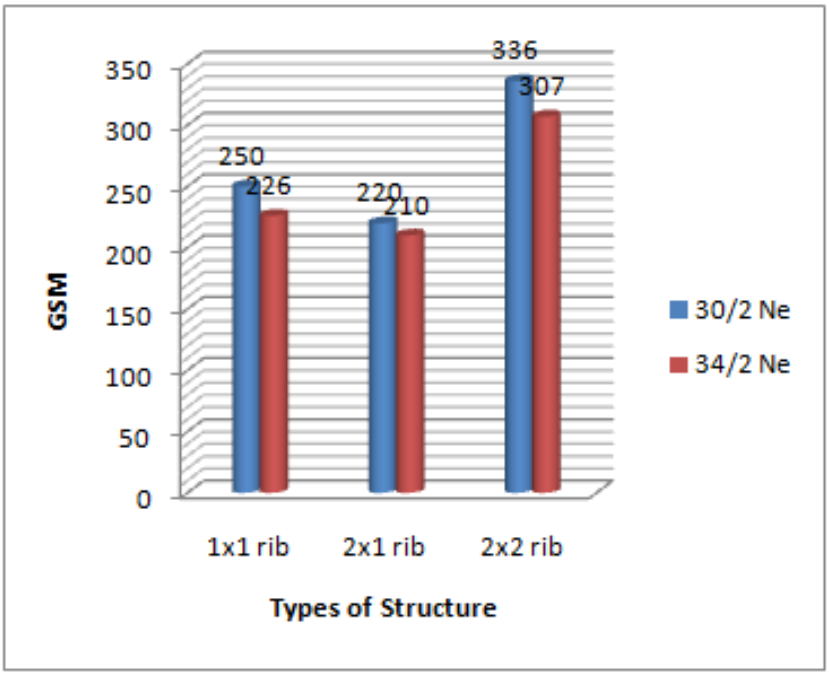

Figure 6: Effect of Fabric Structure and yarn count on GSM

Spirality

Spirality is a dimensional distortion in circular plain knitted fabrics. The wales or needle lines, should occupy a truly vertical line in the fabric and should always be right angles to the cross wise courses of stitches. Balanced structure like 1x1 rib and 2x2 rib have almost no spirality, i.e. 1° but 2x1 structure have slight spirality and the spirality also increases for finer yarn count i.e. 34/2 has higher than 30/2 Ne.

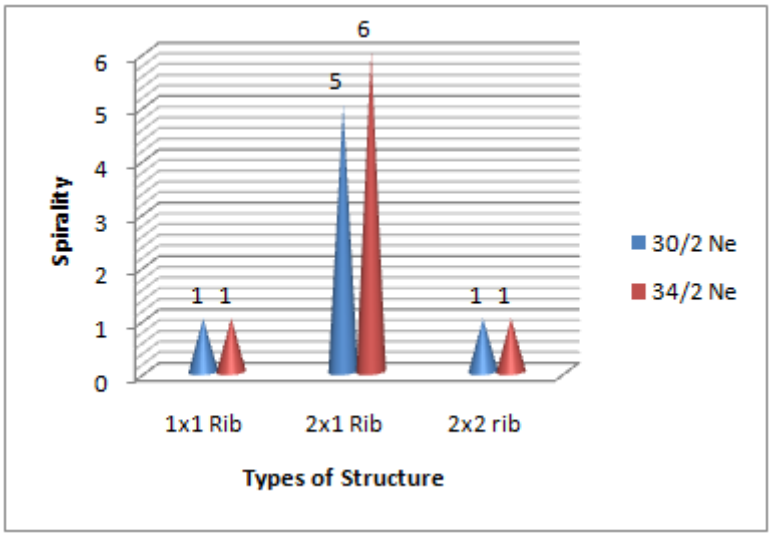

Figure 7: Effect of Fabric Structure and yarn count on Spirality

Tightness factor

Tightness factor is calculated by the following formula,

Tightness Factor $=\sqrt{Tex}/l(mm)$[1] (1)

Tightness factor of 2x1 rib is highest and 1x1 rib is lowest both for 30/2 Ne and 34/2 Ne. Like as stitch density, TF also increase with yarn fineness, i.e. higher for 34/2 Ne yarn than 30/2 Ne yarn for all structures.

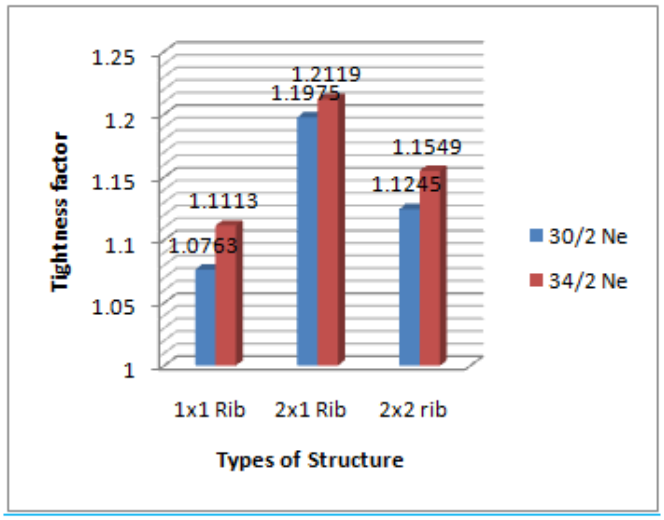

Figure 8: Effect of Fabric structure and yarn count on Tightness Factor

IV. Conclusion

It is found that, the values of properties WPI, CPI, Stitch Density (stich/inch²), GSM, Bursting strength of 2x2 rib is higher than 1x1 and 2x1 rib both for 30/2 ne and 34/2 Ne and tightness factor and spirality of 2x1 rib is higher than 1x1 and 2x2 rib both for 30/2 ne and 34/2 Ne and loop length & WPI is lowest for 2x1 rib. In the is work, we tried to analyze and observe different properties of rib fabric structures and to build up some relations among those. All of data are collected gained by experiments. In some cases our data was limited. The limitation of data may create some undesirable consequences. More data have to be collected to obtain a precise result. Experiments have to be done on the uncommon fabrics.

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