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Effect of Yarn Number and Twist Factor on the Areal Density, Widthwise and Lengthwise Shrinkage of Single Jersey, Rib and Interlock Knitted Fabrics

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Abstract: Investigations were made to study the influence of linear density and different twist factors upon the areal density i.e. weight per unit area of single jersey, rib and interlock fabrics. The collective effect of all these structures for the areal density was found elevated with the increase of twist factor while the trend was reverse for courser yarn counts.

Keywords: Yarn number, twist factor, areal density and interlock kintted fabrics

Introduction

The contribution of knitwear in textile sector export has shown phenomenal growth during the recent years. The knitted fabrics are very soft, elastic, absorbent, durable having wonderful adaptability and are available at comparatively low prices. Despite of all these advantages there are certain quality limitation connected with the knitted fabrics. Dimensional instability is in fact the major drawback of most of the knitwears, which not only varies with the yarn type/count and machine variables but also related to some important fabric characteristics for example the areal density.

Variation in twist factor is responsible for weight per unit area change because more insertion of twist in the yarn makes it stronger with the increase of torsional forces. These forces cause the loops to become closer in knit form and as a result the areal density increases.

Linear density of yarn has inverse effect as produced by twist and tightness factor i.e. by increasing yarn number, weight decreases. Infact, by the increase in yarn number, the diameter of the yarn decreases while it occupies less number of fibres per unit area of yarn. Therefore, if the yarn count is increased by keeping all other variables constant, the weight of the fabric decreases Baily (1998) also concluded that ounces per square yard in reference state are inversely proportional to the product of yarn count and stitch length. The present study was suggested to understand the effect of yarn number and amount of twist insertion in the yarn on the weight per unit area of the single jersey, rib and interlock hosiery cloth types.

Materials and Methods

The present study was initiated in the Department of Fibre Technology, University of Agriculture, Faisalabad and was conducted at Dilkhush Hosiery, Jhang Road, Faisalabad during the year 1998.

- The project was carried out in two phases. In the first phase yarn counts 20^s, 24^s and 30^s were spun from the running cotton variety MNH-93 at twist factors $T_1 = 3.50$, $T_2 = 3.75$, $T_3 = 3.90$, $T_4 = 4.00$ and $T_5 = 4.10$. Before knitting, important quality characteristics of the yarn samples were tested by standard methods of American Society for Testing and Materials as under:
- Testing of yarn number or count by Skein method by making a lea of 120 yards and weighing it, as suggested by ASTM Committee 1997b.
- Yarn twist measurement by twist-untwist method of a unit length of sample as suggested by ASTM Committee 1969.
- Yarn irregularity assessment by the procedure advised by ASTM Committee 1997a.
- Yarn Skein Strength measurement by application of constant rate of load increase as recommended by ASTM-Committee 1997d.
- In the 2nd phase, the following fabrics were knitted from the above prepared yarn samples at the following machines (keeping the yarn tension, take down tension value, gauge value and cylinder speed value constant):

I	Single Jersey TERROT type : S-196		$= M_1$
II	Rib	ALBI type : RJH	$= M_2$
III	Interlock	ALBI type : RJH	$= M_3$

The knitted fabric samples were tested for their areal density by standard method suggested by ASTM Committee (1997e). The data was statistically analysed for variance and least significant difference Test (LSD Test) was applied to interpret and evaluate the results as suggested by Steel and Torrie (1984).

Results and Discussion

The statistical analysis of variance and comparison of individual means for areal density of the fabrics is presented in table 1a and table 1b. It shows that the linear density of yarn (C). Twist factor (T) and type of knitted apparel (M) produced highly significant results while the interaction of linear density and twist factor gave non-significant effect upon the areal density.

The comparison of individual means for twist factors is shown in the table 1b illustrates that the mean values of areal density for different twist levels of yarn i.e. T_1, T_2, T_3, T_4 and T_5 are 153.9, 163.2, 171.6, 178.5 and 184.3 g/m^2, respectively. It reveals that weight per unit area of the fabric increases as the twist factor is increased. the reason might be due to the fact that with increase in twist level, forces of tension increases and they make the loops to become closer to each other; so, weight of the fabric increases. This finding is also supported by the work of Sharma *et al.* (1985) who reported that with the increase in twist level, stitch density and areal density was found to be higher at all relaxation levels in accordance with this formula:

$$\text{Weight of the knitted cloth per unit area} = \frac{K.\ tex}{10.\ L}$$

(K is geometric constant for stitch density and
l = Stitch length)

Table 1a: Analysis of variance for areal density

S.O.V.	d.f	S.S.	M.S.	F-value	Prob.
Machine (M)	2	846528	423264	14898.4	0.0038**
Count (C)	2	22729	11364.5	400.0	0.0003**
Twist (T)	4	49135	12283.7	12283.7	0.0000**
M x C	2*	3816	1908	67.1	0.0000**
M x T	8	285	35.6	1.2	0.3972N.S
C x T	8	233	29.1	1.0	0.0021**
Error	119	4709	21.7	1.0	
Total	145	927435	1752.6	71.4	

** = Highly Significant N.S = Non-significant

Table 1b: Comparison for individual mean values

Twist factor	Yarn count	Machine Type
T_1 = 153.9 e	C_1 = 180.6 a	M_1 = 130.8 c
T_2 = 163.2 d	C_2 = 169.2 b	M_2 = 161.5 b
T_3 = 171.6 c	C_3 = 142.2 c	M_3 = 238.4 a
T_4 = 178.5 b		
T_5 = 184.3 a		

Entries carrying different letters differ significantly at 5% level of probability.

The present findings are also in accordance with the statements given by Doyle (1953), Mundan (1959) and Black (1974). Similarly, Baily (1998) concluded that ounces per square yard in reference state are inversely proportional to the product of the yarn count and stitch length.

Comparison of individual means by applying LSD test indicates that the mean values of area density are 180.6, 169.2 and 142.2 for counts C_1 (20^s), C_2 (24^s) and C_3 (30^s), respectively. this gradual decrease in weight of the fabric samples might be due to the reason that with increase in yarn count, the diameter of the yarn decreases which contributes a decrease in weight per unit area of the fabric. This doctrine is also supported by the findings of Sharma and Agarwal (1986) who reported that weight per unit area of the knits decreases as the tex value of yarn decreases.

Comparison of individual means for different kinds of knitted apparel (M) i.e. single jersey (M_1) rib (M_2) and interlock (M_3) are also presented in table 1b. The highest mean value of areal density is observed for interlock (M_3) as 238.4 g/m^2 and the lowest mean value as 130.8 g/m^2 achieved for single jersey (M_1). It reveals that areal density of knitted fabrics not only depends upon tex of yarn and stitch length but also upon the K_s value (geometric constant for SD). The value of interlock is high due to the double knit structure of this type of knit. The values of areal density for single jersey (M_1), rib (M_2) and interlock (M_3) were also found as 32.1, 63.7 and 152.0 g/m^2 by Knapton and Fong (1970) which confirm the above results.

Conclusion

By increasing the twist factor of yarn, the areal density of cloth knitted from this yarn increases, on the other hand it decreases with the increase in the yarn number. Besides this, the weight per unit area of interlock knit is found the highest, ranking that of rib as intermediate and of single jersey as the lowest.

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