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COMPARISON BETWEEN PHYSICAL AND MECHANICAL PROPERTIES OF WEFT KNITTED FABRICS PRODUCED FROM SIRO AND RING SPUN YARNS

Part I - Physical Properties

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ABSTRACT

As the physical and mechanical properties of the siro spun yarns are different from that of the ring spun yarns, the present investigation translate the effect of this difference into the properties and geometry of the fabrics knitted from both kinds of yarns. It is well known[1,5] that the siro spun yarns are more strong, less hairy, and of low pilling tendancy. Ring spun ply yarns have been introduced in this study to complete the comparison between single

INTRODUCTION

The knitted fabrics cover a considerable sector of the the textile industry generaly in form of garments. The weft knitted fabrics as a geometrical structure have their own physical and mechanical properties which depend upon those of the yarns made from them [6,7].

Siro-spinning is fairly, new technique in yarn production widely used now in the worsted yarn production mainly in Australia [1,2,3,4]. In case of spinnirg siro-spun from short staple cotton fibres and cotton ployester blends, some researchers [2,3,5] have pointed out, that the Siro-Spun yarns have better-eveness, and higher tenacity ccmpared with normal ring-spun yarn, but still lower than those of the ply yarns.

Scope of the present work

In this part, comparison between the mechanical properties of the knitted fabrics produced from siro, ring single and ply yarns are carried out. These properties are the fabric abrasion resistance, bursting strength, and the crease recovery. The effects of yarn tension during knitting, yarn count, and knitting design on the mechanical properties of all knitted fabrics produced are investigated.

Design of Experiments

The raw material used within the present work are 100 % cotton yarns, the specifications of which are given in table 1 part I.

The yarns were knitted individually into weft-knitted fabric on the Dubied circular knitting m/cs of gauge 18. The m/cs have each 24 feeders. The yarns were fed into the m/cs under different tensions. The yarn tension was varied between 1 gr/tex and 3 gr/tex. The design of knitting is 1/1 rib or 2/2 rib structure. The following properties of the produced fabric were measured and listed out:

1. Abrasion resistance 2. Bursting strength in Kg
3. Crease recovery.

Results and Discussion

Mechanical Properties of the Knitted Fabric.

Among the different mechanical properties of any fabric, only the following properties were studied, which are of more importance for the knitted fabrics. These are the fabric abrasion resistance, bursting strength, and the crease recovery.

Fig. (5) gives the relationship between the yarn tension and the abrasion resistance of the 1/1 rib knitted fabric, knitted from N_m 50 and N_m 66 single, siro, and the equivilent ply count. In general, the abrasion resistance is improved slightly by increasing the yarn tension. However, the improvement of the abrasion resistance of the knitted fabrics from the single yarns is considerably more than that of the fabrics from ply yarns and than that of the fabrics from siro spun yarns.

These results can be related to difference in the structure of the three types of yarn . The single yarn, which has more protruding fibres, and therefore less abrasion resistance will show less abrasion resistance in fabric. The interlacing of the yarns in the fabric supports the protruding fibres to the yarn body. The more suporting points (due to the increasing of the number of stitches per unit area) leads to the increase of the abrasion resistance of the cloth. Also, the reaction between the yarns in the fabric is increased due to the increase of the yarn tension during knitting, which gives more support to the protruding fibres.

As the ply yarns have less hairiness and accordingly less protruding fibres as well as the frequent supporting points due to the twist of the two singles, the increasing of the number of stitches per unit area, due to the increased yarn tension, causes less improvement in the fabric abrasion resistance.

For the fabric knitted from the siro spun, which has better fibre migration (3,4,5) with less protruding fibres, than the ring spun yarns, the increase of the number of

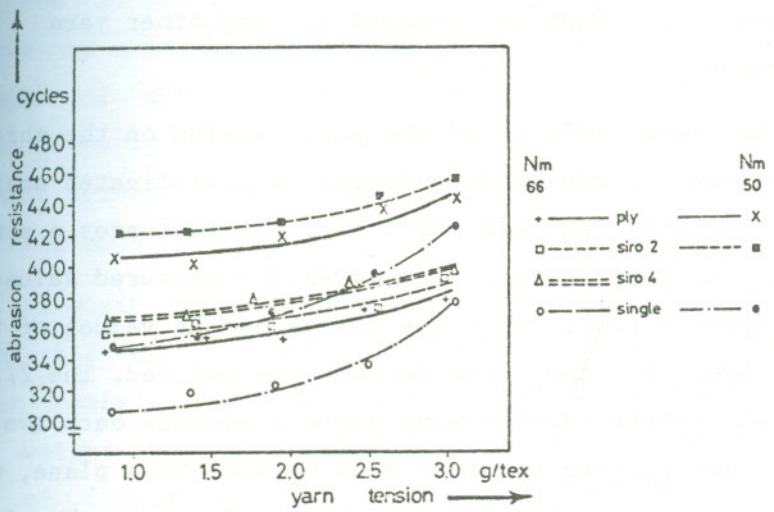

Fig.(5) Effect of yarn tension on the abrasion resistance of 1/1 rib knitted fabric

stitches per unit area has a smaller effect on the abrasion resistance of the knitted fabric produced. In other words, the fabric abrasion resistance is more or less independent on the yarn tension.

For the same reasons, the knitted fabric from siro spun yarn shows in general better abrasion than both fabrics knitted from single ring spun yarn and from the ply yarn of an equivilent yarn count.

The use of siro "4" produces knitted fabric of better abrasion resistance compared to that of fabrics knitted

with siro "2". This result can be related to the structure of both yarns. The use of 4 rovings, each two to produce one end of a siro spun yarn and then twisting the two ends together to produce siro "4". The fibres are more tightend to the yarn body in compared to any other yarn structure.

The same effect of the yarn tension on the abrasion resistance of the knitted fabric is investigated again in case of knitting 2/2 rib. Fig. 6 illustrates a similar effect to that in fig. 5. However, the measured values are considerably lower than the corresponding values of the 1/1 rib, even if the same tendency is noticed. The 2/2 rib knitted fabric shows a wavy surface because each two face wales are running together side by side in a plane, while the next two back wales are running side by side in another plane. The abraded area is therefore less with

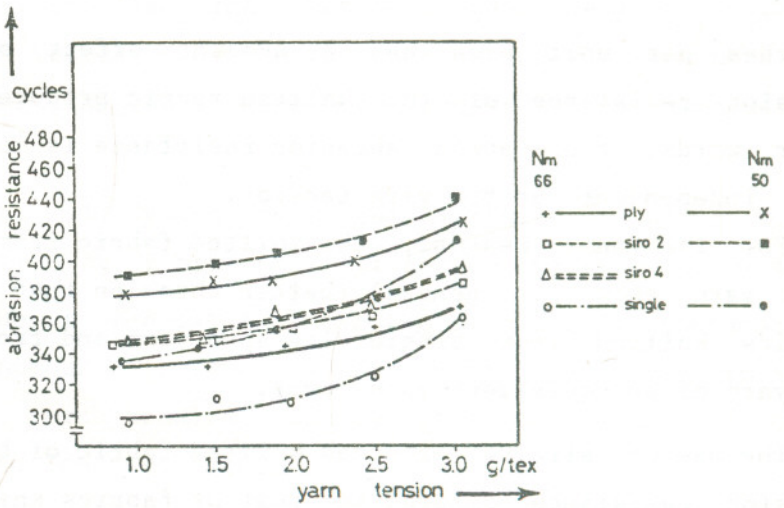

Fig.(6) Effect of yarn tension on the abrasion resistance of 2/2 rib knitted fabric

small number of stitches than that of the 1/1 rib, in which structure the distance between the wales is reduced and accordingly more face wales are to be abraded. The difference in the abrasion property of the 2/2 rib knitted fabric due to the use of the different types of yarns is the same as noticed by knitting 1/1 rib. This means that the types of the yarn has a significant effect on the abrasion property of the knitted fabric. The ply yarns and then siro spun give better abrasion resistance than the single ring spun.

It is worth mentioning that in both cases of knitting 1/1 and 2/2 rib, the use of coarser counts gives better abrasion resistance due to the effect of the count on the fabric weight per unit area, the yarn thickness, the number of fibres in yarn cross-section and the surface quality of the fabric.

As the bursting strength has its widest application for knitted fabrics [8], it is used here to indicate the fabric strength. The relationship between the yarn tension and the fabric bursting strength is shown in Fig. 7 in case of using the different yarns to knitt 1/1 rib. It is clear that the bursting strength in general for all yarn types increases by increasing the yarn tension. This increase in fabric bursting strength may be related to the increased number of stitches per unit area of the fabric, und due to the more supporting effect at the interlacing points of the yarns.

However, the increasing rate in bursting strength is relatively higher in case of fabrics knitted from single yarns than ply yarn than the siro spun yarns. This results

may be related to the structure of yarns its self. The cohesion between the fibres within the yarn body, which depends on the twist and fibre migration from the surface into the inner layers of the cross section and vice versa, is in the siro spun more than in the single. In the same time, the plying of two singles together offers frequent

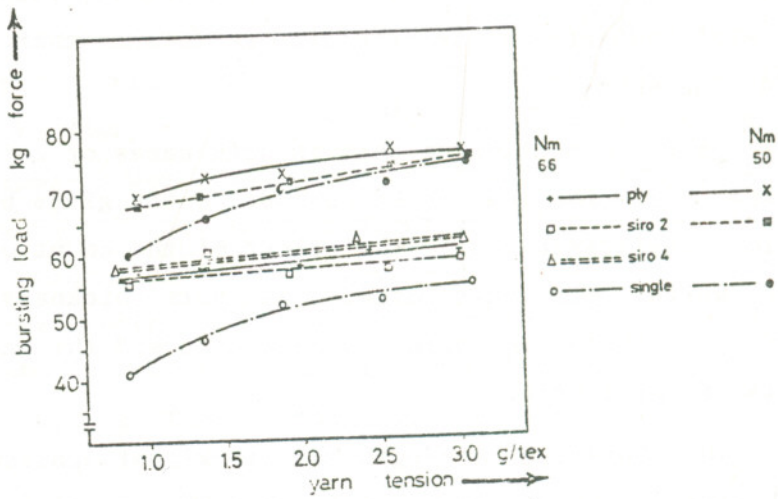

Fig.(7) Effect of yarn tension on the bursting load of 1/1 rib knitted fabric

supports of the protruding fibers as well as radial pressure which increases the fibre cohesion. Therefore, the increased supporting effect is less effective in the cases of ply and siro-spun yarns. In the same way, it could be explained, why ply und siro spun yarns produce fabrics with higher bursting strength.

In case of knitting 2/2 rib, the yarn tension shows a similar effect as shown in fig. 8. These results can be explained in the same way used in case of 1/1 rib. However,

it was found that, the 2/2 rib fabrics gives values for the bursting strength in the range 10 to 15 % less than the 1/1 rib knitted fabrics. This difference can be related to the less weight per unit area resulted from the less number of stitches per unit area in case of 2/2 rib kniitted fabrics.

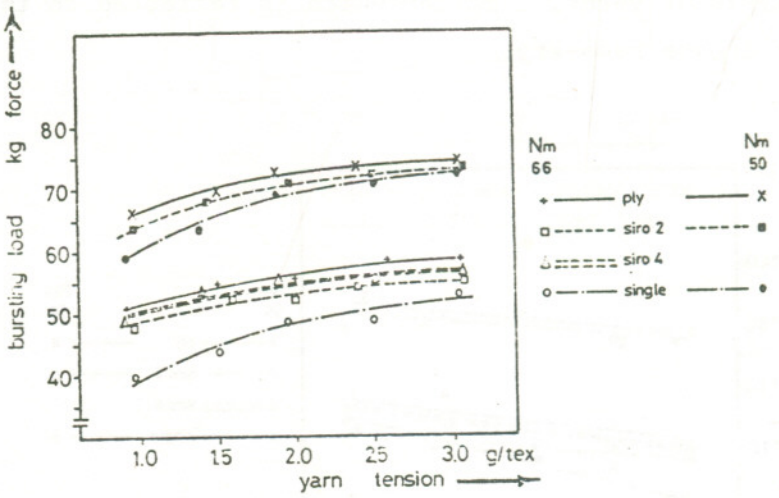

Fig. (8) Effect of yarn tension on the bursting load of 2/2 rib knitted fabric

The crease recovery is another important property of knitted fabrics. Fig. 9 illustrates the effect of the yarn tension on the crease recovey of the 1/1 knitted fabric from single, siro spun and ply-yarn of count 50 and 66. It could be seen that, there is a small tendency that the recovered angle increases by increasing the yarn tension. Also, it is found that the use of single yarns produces knitted fabrics having an infirior crease recovery in comparison with fabrics knitted from siro spun und ply garns. The increase of the yarn tension during knitting

causes an increase in the weight of the fabric per unit area as well as the stitches are more tighted together. Both of the two factors cause an increase in the firminess of the cloth and accordingly more recovery from the deformation. In case of the single yarn, the yarn has relatively small stiffness compared to that of the other two types of yarns, a matter which is reflected to the fabric crease recovery.

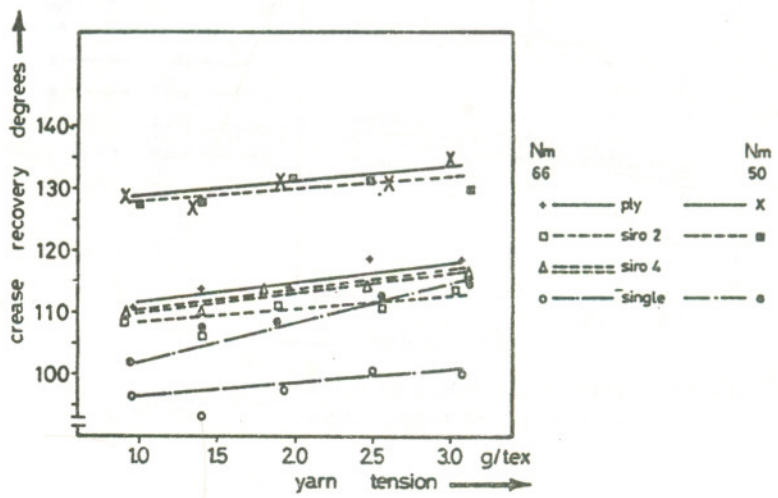

Fig. (9) Effect of yarn tension on the crease recovery of 1/1 rib knitted fabric

A similar relationship is observed again between the yarn tension and the fabric crease recovery in case of knitting 2/2 rib as shown in Fig. 10 using the same yarn types. The only difference between the results in each case of the two types of fabric structure is that the 2/2 rib shows less crease recovery due to the less fabric weight per unit area and the less tightness between the face and back wales.

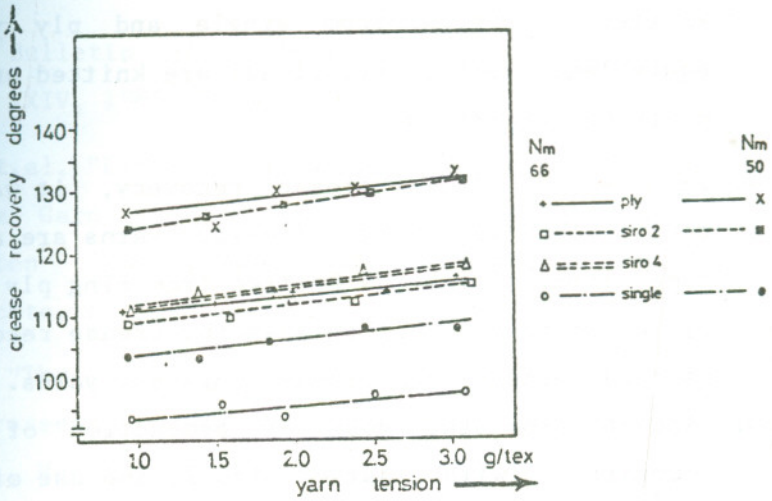

Fig. (10) Effect of yarn tension on the crease recovery of 2/2 rib knitted fabric

Conclusions

From the previous results, the following conclusions can be drawn out in case of producing weft knitted fabrics :

1. Siro spun yarn may represent a probable replacement for the ply yarn of an equivilent count. It can be used to produce a weft knitted fabric of lower cost.
2. Under the same knitting conditions, and exceptionally for the abrasion resistance, the knitted fabrics produced from the siro spun might have properties in the level between that of both fabrics knitted from ring single and ply yarns of an equivilent count.
3. The abrasion resistance of the knitted fabrics from siro-spun yarns is considerbly higher than that of

knitted fabrics from single and ply yarns of an equivilent yarn count, if all are knitted under the same knitting conditions.

4. In case of faric crease recovery, it was found that fabrics knitted from siro-spun yarns are almost of the same level of fabrics knitted from ring ply yarns, which is considerably higher than the crease recovery of that fabrics knitted from single ring-spun yarns.
5. Appart from the cost of production of siro 4 in comparison with that of siro 2, the use of siro 4 as a raw material for weft knitted fabrics gives better abrasion resistance and higher bursting strength.

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References

[1] International wool secretariate (IWS), U.K. Report, November 1981.

[2] Schwabe, B., Textiltechnik, 25, No. 7, 416, 1975.

[3] Garnsworth, D plate, J.T.I., 1981.

[4] Zinser Cataloge "Siro-spun a new technique eliminating the twisting processes 1983, Zinser Textilmaschinen Fabric, West Germany.

[5] El Hawary " A comparative study between the properties of siro-spun and normal ring-spun cotton yarns," Bulletin of the faculty of Engineering, Alex. Univ., Vol. XXIII, 1984 P 13.

[6] El-Okeily M., "On the dimensional stability of knitted

fabrics," Bulletin of the Faculty of Engineering, Alex. Univ., Vol XXIV, 1985, P 443.

[7] V. Havas et.al, "Einfluss verschiedener Kombinationen von gesponnenem Garn und texturiertem Filamentgarn auf die Eigenschaften von Rund strickwaren," Milliand textilberichte, 61 Heft 11 1980 S. 924.

[8] El-Okeily "The performance of knitted garments under weaving stresses" Bulletin of the Faculty of Engineering, Alex. Univ., Vol XXIV, 1985, P 563.

[9] El Helw et al" Comparison between physical and mechanical properties of weft knitted fabrics produced from siro and ring spun yarns, Part I, Alex. Eng. Journal, Vol, 27, No.3 1988.