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# Some Trials on the Production of Wool-Rich 5-Needle Queenscord Fabrics

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# SOME TRIALS ON THE PRODUCTION OF WOOL-RICH 5-NEEDLE QUEENSCORD FABRICS

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## ABSTRACT

*A 5-needle Queenscord was selected to produce "wool-rich" warp knitted fabrics on a 36-gauge Raschel machine. A textured polyester filament on the front bar and an intimate blend yarn of wool and nylon on the back bar giving a fabric containing 61% wool, proved to be superior to other fabrics made from polyester on the front bar and wool/nylon corespun on the back bar or intimate blends of wool and nylon on both bars. Heat setting is preferred to autoclave decatizing as a means of setting the fabrics.*

## KEY WORDS

Warp knitting – Queenscord – intimate blend-corespun – nylon/wool – polyester – deformability – breaking load – extension at break – pilling – air permeability – flex abrasion – area shrinkage – autoclave decatizing – heat setting.

## INTRODUCTION

In recent years, warp-knitting has become increasingly important in the outerwear fields. Originally, continuous flat filament synthetic yarns were mainly used on the finer gauge warp-knitting machines. During the past few years, however, there has been a distinct movement towards the use of textured yarns with a large part of the warp-knitting business preferring the use of slightly coarser gauge Tricot machine and eventually fine-gauge Raschel machines[1]. This change may be attributed mainly to the increase in popularity of polyester/cotton fabrics, the development of jersey fabrics from spun yarns to reduce porosity and the aversion to the feel of 100% synthetic material. Several articles on this topic, have appeared recently[2–6] most of them dealing with cotton yarns in either pure or blended form.

These developments prompted SAWTRI to investigate the knitting behaviour of wool and wool-rich worsted yarns on a 36-gauge Raschel machine, using a 5-needle Queenscord as a typical example of the type of structure which can be knitted on Raschel machines.

## EXPERIMENTAL

**Yarn Count:**

A number of trials were carried out using different counts of pure wool worsted yarn with a twist factor of 2 818 (2,4 worsted) on the second bar. These preliminary experiments showed that a 22 tex yarn was about the *finest* which could be knitted with a reasonable fault rate on a 36-gauge (i.e. 18 needles per inch) Raschel machine. It was therefore decided to compare the knitting performance of 22 tex corespun and intimate blend yarns as well as the physical properties of the resulting fabrics.

**Comparison of Different Blend Compositions:**

A number of 5-needle Queenscord structures were knitted from two different yarn types viz. –

(a) Corespun yarns of linear density 22 tex containing a continuous untextured nylon core of 110 dtex giving a fabric containing 80% wool and 20% nylon.

(b) Intimately blended spun yarns of 22 tex comprising *25% nylon staple and 75% wool fibre.*

All yarns containing wool were treated with 4,5% DCCA.

Initially two structures were knitted using either yarn type (a) or yarn type (b) on both bars. The experiments were subsequently repeated utilizing a continuous filament textured polyester yarn of *110 dtex on the front bar.*

The number of knitting defects in all of these fabrics was determined over fabric lengths consisting of 9 000 knitted courses (7 metres).

**The Effect of Specific Yarn Preparation Methods:**

Beams were made from both unwaxed and waxed wool-rich blend yarns in an attempt to establish the effect of waxing on the knitting performance of the yarns and on some of the physical properties of the finished fabrics (see Table I). Conventional paraffin wax discs were used to wax the yarns on a cone-winder prior to beaming.

**The Effect of Different Finishing Procedures:**

Two different routines were employed in the finishing of the fabrics viz.–

A. Crabbing, winch scouring, tenter-setting, winch dyeing, drying and final decatizing.

B. The same as above but instead of tentering the fabrics were set on an autoclave-decatizer.

The physical tests listed in Table I, indicate which of the two routes is to be preferred.

**Physical Tests Performed:**

All the 5-needle Queenscord fabrics were tested for the following properties:

(a) Fabric breaking strength and extension using the I.S.O. test method[7].

(b) Deformability using the SAWTRI test method[8].

(c) Fabric mass and air permeability[9] on a WIRA Air permeameter utilising 1 cm and 5 cm water pressure respectively.

## TABLE I

### KNITTABILITY AND PHYSICAL PROPERTIES OF DYED 5-NEEDLE QUEENSCORD FABRIC

| | Structure: Front Bar 2–0, 0–2 / Materials: Front Bar | Structure: Back Bar 10–12, 2–0 / Materials: Back Bar | % Wool | No. of Defects (per 9 000 courses) | Finishing Procedure | Fabric mass (g/m²) | Tensile Properties: % Deformability Warp | % Deformability Weft | Breaking Load (kg) Warp | Breaking Load (kg) Weft | % Extension Warp | % Extension Weft | Pilling (No. of Pills) per 1 000 cycles: On Disc | Pilling: On Square | Appearance after pilling | Air permeability (cm³/sec/cm² fabric/cm water pressure): At 1 cm water pressure | At 5 cm water pressure | Flex Abrasion (Cycles to rupture): Warp | Flex Abrasion: Weft | AKU wrinkling at high RH: Warp after 1 hr relax | Weft after 1 hr relax | AKU Wrinkle Recovery: High RH (Average of Warp (Weft) | Low RH (Average of Warp (Weft) | Area Shrinkage: After 3 min wash | After 48 min wash |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WAXED | Polyester | Corespun | 65,5 | 2 (Corespun) | Autoclave Dec | 264 | 5,45 | 1,23 | 32,9 | 91,0 | 52,9 | 68,1 | 0 | 0 | Very good | 15,4 | 14,0 | 228 | 357 | 0,12 | 0,18 | 18 | 14 | 2,7 | 3,3 |
| | | | | 1 (Polyester) | Heat Set | 316 | 5,46 | 1,14 | 27,8 | 96,1 | 49,6 | 67,4 | 0 | 0 | Very good | 19,6 | 17,4 | 255 | 355 | 0,16 | 0,23 | 17 | 12 | 2,9 | 3,2 |
| | Corespun | Corespun | 80,0 | 252 (Pillar) | Autoclave Dec | | | | | | | | | | | | | | | | | | | | |
| | | | | | Heat Set | | | | | | | | | | | | | | | | | | | | |
| | Polyester | Intimate Blend | 60,7 | 0 | Autoclave Dec | 269 | 5,70 | 1,15 | 34,3 | 70,9 | 54,8 | 62,4 | 13 | 0 | Good | 15,8 | 13,9 | 774 | 932 | 0,14 | 0,15 | 11 | 18 | 2,9 | 4,5 |
| | | | | | Heat Set | 273 | 6,41 | 1,00 | 40,2 | 81,7 | 67,9 | 60,5 | 15 | 0 | Good | 17,1 | 15,4 | 869 | 1062 | 0,09 | 0,26 | 15 | 15 | 2,9 | 3,6 |
| | Intimate Blend | Intimate Blend | 75,0 | 5 (Pillar) | Autoclave Dec | 296 | 6,28 | 1,39 | 22,6 | 62,1 | 59,5 | 65,7 | 15 | 1 | Good | 18,8 | 15,8 | 343 | 616 | 0,19 | 0,27 | 23 | 4 | 4,8 | 5,7 |
| | | | | | Heat Set | 260 | 6,36 | 1,59 | 23,4 | 70,6 | 63,4 | 69,4 | 32 | 5 | Bad | 19,2 | 16,8 | 443 | 819 | 0,13 | 0,20 | 18 | 4 | 4,5 | 5,5 |
| UNWAXED | Polyester | Corespun | 65,5 | 6 (Corespun) | Autoclave Dec | 259 | 5,13 | 0,89 | 35,1 | 93,6 | 55,5 | 69,3 | 0 | 0 | Very good | 22,5 | 13,7 | 183 | 372 | 0,17 | 0,16 | 17 | 16 | 1,9 | 2,4 |
| | | | | | Heat Set | 252 | 5,48 | 1,14 | 35,0 | 93,4 | 55,4 | 65,7 | 0 | 0 | Very good | 25,4 | 20,7 | 278 | 327 | 0,16 | 0,23 | 17 | 15 | 2,7 | 3,4 |
| | Polyester | Intimate Blend | 60,7 | 0 | Autoclave Dec | 261 | 5,02 | 1,35 | 34,5 | 70,7 | 52,7 | 64,7 | 13 | 0 | Good | 16,3 | 14,6 | 631 | 595 | 0,16 | 0,20 | 17 | 18 | 3,6 | 4,4 |
| | | | | | Heat Set | 257 | 5,16 | 1,04 | 36,8 | 73,0 | 60,0 | 59,2 | 16 | 2 | Good | 18,3 | 16,3 | 850 | 897 | 0,14 | 0,27 | 8 | 18 | 3,4 | 4,1 |

(d) Flex abrasion.
(e) Pilling on a Martindale apparatus using a 0,78 kg weight and the number of pills determined after 1 000 cycles.
(f) AKU wrinkling in –
  (i) an atmosphere of 75% R.H. at 30°C; and
  (ii) an atmosphere of 10% R.H. at 90°C; and applying a load of 3,5 kg for 20 min.
(g) AKU wrinkle recovery in an atmosphere of 65% R.H. at 20°C. Two judges made a subjective ranking after 48 hours relaxation giving a score of 0 as the best and 30 as the worst. The mean scores were then averaged for the course and wale directions.
(h) Shrinkage of the fabrics, washed according to Australian Wool Board specifications[10].

The results of the various tests are given in Table I.

## RESULTS AND DISCUSSION

It was found that a 5-needle Queenscord structure could be knitted at a reasonable fault rate using either polyester or an intimate blend of wool/nylon yarn on the front bar and corespun or intimate blend yarns on the back bar. Table I shows that it was impossible to knit the same structure using corespun yarns on both bars. It has, however, been found that this structure could be knitted successfully if corespun yarns with a higher twist (twist factor 3 987) were used.

During the knitting of the structures containing wool-rich blends on both bars, some difficulty was experienced in knitting the structure with corespun yarn on the front (pillar) bar. It was considered that the situation could be improved by lubricating the yarn on the machine with a commercially available lubricating wax. This was applied by means of an aerosol spray. It was soon apparent, however, that this procedure did not improve the knitting performance.

All fabrics were of medium weight with the fabrics which were heat set, slightly heavier than the autoclave decatized fabrics. This may be due to shrinkage of the polyester filament and nylon core during heat setting since a 5% overfeed was used during the setting process.

Deformability of the fabrics was low (see Table I) with no significant difference between the various fabrics. The breaking strengths of the fabrics were satisfactory with that of the intimate blend fabric on both front and back bar being lower than that of the fabrics containing either corespun or polyester yarns. This can be explained by the fact that continuous filament yarns tend to be stronger than staple yarns of similar count. This also explains the slightly lower breaking strength values, in the weft direction, of the fabrics knitted with polyester on the front bar and the intimate blend on the back bar.

The pilling propensity of all the fabrics was found to be good, especially of those fabrics knitted from the polyester filament and corespun yarns. The flex abrasion of the latter fabrics was low, however, due possibly to differential wear. The pilling propensity of the polyester filament and intimate blend fabrics was relatively high but their flex abrasion was higher than that of the polyester/corespun fabrics. The pills were small, however, and considering the increase in flex abrasion the former is considered to be the superior fabric. Table I also shows that the flex abrasion of most of the heat set fabrics was higher than that of the autoclave decatized fabrics. This may be due to some damage of the wool during the autoclave decatizing process.

The air permeability of the autoclave decatized fabrics was lower than that of the heat set fabrics. This may be attributed to the lateral pressure on the wrapper roll during autoclave decatizing which would yield a fabric more compact than one which had been heat set.

No significant difference was found between the various fabrics in their AKU Wrinkling at high humidity. At high relative humidity, however, the wrinkle recovery of the polyester (bar 1)/intimate (bar 2) blends was the best with that of the polyester/corespun fabrics intermediate and that of the fabric produced from intimate blend yarns appeared the worst. Under low relative humidity conditions the wrinkle recovery properties were reversed with the intimate blend fabrics being the best, the polyester/corespun fabrics again intermediate and the polyester/intimate blend fabrics the worst.

All these fabrics passed the Australian Wool Board wash test specifications. The difference in area shrinkage was very small, with the polyester/corespun fabrics perhaps slightly better than the others.

## SUMMARY AND CONCLUSIONS

After a series of knitting trials and subsequent subjective evaluation it was found that in the case of a 5-needle Queenscord structure a texturised continuous filament polyester yarn on the front bar and yarns comprising an intimate blend of wool and nylon on the back bar seemed to produce superior fabrics whether the yarns were waxed or not. Heat setting gave results which were superior to those given by autoclave decatizing.

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