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Knit-de-Knit in a Polyester/Cotton Blend

by

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ABSTRACT

Knit-de-knit body blanks were produced in various stitch lengths from approximately 67/33 polyester/cotton blend yarns, and a ratio equal to $\frac{\text{final stitch length } (\ell_f)}{\text{original stitch length } (\ell_o)}$ *for the various tex yarns was calculated. A value for this ratio of 1,77 was found to give the most attractive bouclé effect with acceptable fabric stability. The relaxed dimensions of the various fabrics were measured and the corresponding dimensional constants (K_{1-4} values) were calculated. These were found to be dependent upon the final stitch length.*

KEY WORDS

Polyester/Cotton – original stitch length – final stitch length – knit-de-knit – relaxation – heat-setting – steam-setting – k-values.

INTRODUCTION

Knit-de-knit is a comparatively new but established method of producing a characteristic bouclé effect in knitted garments. This bouclé effect apart from giving the garment an attractive appearance, imparts elasticity and "clinginess" to the garment, and these two properties are very much in vogue at the present time.

The principle of producing knit-de-knit garments is quite simple and the process is as follows:–

yarn is knitted into a structure, dyed and set. The yarn is then unravelled by winding onto cones and then re-knitted into a final structure, relaxed and finally made up into a garment.

Rowbotham[1] stated that one of the major considerations in knitting was yarn technology of which the knit-de-knit process is a typical illustration. His initial work with 100% cotton, knitted and then resin-treated, showed some problems during unravelling. Although a 50/50 polyester/cotton blend appeared to be promising he selected the 67/33 polyester/cotton blend yarn which unravelled the best and presented the least problems during processing. The knit-de-knit process is also used for producing bulky wool yarns for curly-pile carpets. The setting and stabilisation of this type of yarn is described in detail by Delminico and Narsian[2]. An I.W.S. publication[3] describes the knit-de-knit process in respect of all-wool garments, and a comprehensive guide to all the types of multiple head machines specially built for producing knit-de-knit yarns can be found elsewhere[4].

According to Brown[5], in the case of the all-wool knit-de-knit process, the original knitting should be carried out as tight as possible and the final knitting accomplished as slack as possible, without creating a flimsy unstable fabric. The body blanks should then be allowed to wet relax prior to making up and the garments finally set to the required size in an autoclave.

The main criterion of the knit-de-knit process is that the yarn must be able to be heat-set, for example, nylons, polyesters, acrylics, etc., or in the case of wool, steam-set. The fabrics can then be set by applying heat or steam. 100% cotton does not possess such characteristics. It is possible that certain blends of thermo plastic and natural fibres can have heat setting properties and it was in fact found that a 67/33 polyester/cotton blend can be heat-set to give an acceptable knit-de-knit yarn[6], although in the experience of the authors the 50/50 polyester/cotton blend yarns do not respond sufficiently to a heat-setting treatment and consequently the resultant fabrics are unsatisfactory.

It was suggested by Brown[5] that for all-wool R63 Tex/2 yarns the ratio final stitch length to initial stitch length (β) should be about 1,41 to give an acceptable bouclé effect with good fabric stability. The present report is confined to an investigation into the knit-de-knit processing of 67/33 polyester/cotton yarns of which the object was to determine the effect of original stitch length (ℓ_o), and final stitch length (ℓ_f) on the resultant bouclé effect using three different yarn linear densities. The original stitch length was governed by the yarn tex.

EXPERIMENTAL

Two 67/33 Polyester/Cotton commercially spun hosiery yarns of nominally 20 tex and 16 tex were folded to give R40 tex/2 and R32 tex/2 yarns respectively, and folding tex twist factors of 53 were used. Two ends of a 26 tex yarn comprising 70/30 polyester/cotton were also knitted.

During preliminary trials it was found that the yarn was difficult to unravell after dyeing and setting, and therefore it was decided that the yarn should be dyed prior to original knitting. The yarns were scoured and package-dyed in one bath (using Terasil Dispersal dyestuffs (Ciba Geigy) for the polyester component, and Solophenyl Direct dyestuffs (Ciba Geigy) for the cellulosic component) in a Vald Henricksen pressure dyeing machine. After dyeing the yarn was rinsed, hydro-extracted and dried at 50°C. The yarns were cleared and waxed during subsequent cone winding.

The original knitting was carried out as tight as possible on a Lawson Fibre Analysis Knitter, Model FAK, with 220 needles on 8,89 cm (3½") diameter, see Table I for details. The tubular fabric produced was set in an Andrew's Autosetter, steamed for 10 minutes at 130°C and two minutes exhaustion at a vacuum pressure of 660 mm of mercury. The fabrics were allowed to cool and condition for 24 hours at 65% RH and 20°C before unravelling under low tension on a Schweiter Cone winder (9° 15' cones).

The final knitting was carried out on a Scheller straight bar, 24 gauge (16 needles per inch) fully fashioned machine. A series of body blanks were knitted using different stitch lengths.

The first sample was knitted very slack after which the machine setting was progressively tightened for each sample until 15 samples had been knitted from each yarn. The stitch lengths of the samples were determined by unravelling before relaxation. Subsequently the fabrics were wash relaxed by tumbling in the Cubex in a 1,25% phosphate buffer solution in 9 litres of water at 40°C for 3 minutes, followed by a 30 minute wash. The fabrics were allowed to dry relax for a minimum of 72 hours before measuring the dimensional properties of the fabrics.

Each series of fabrics were numbered 1–15 according to the machine tightness setting at which the body blanks were knitted, and these were laid out on a table and 10 judges were asked to rate the fabrics according to the most acceptable bouclé effect. Each judge selected what he considered to be the best three fabrics taking into account the appearance and handle of the fabrics. From the numbers of the selected fabrics the average rankings were determined and the most acceptable stitch length value obtained.

Garments were produced from fabrics knitted at this stitch length (l_f) for each yarn, and Fig. 1 is an illustration of a conventionally plain knitted fabric compared with a knit-de-knit fabric knitted at optimum knit-de-knit ratio.

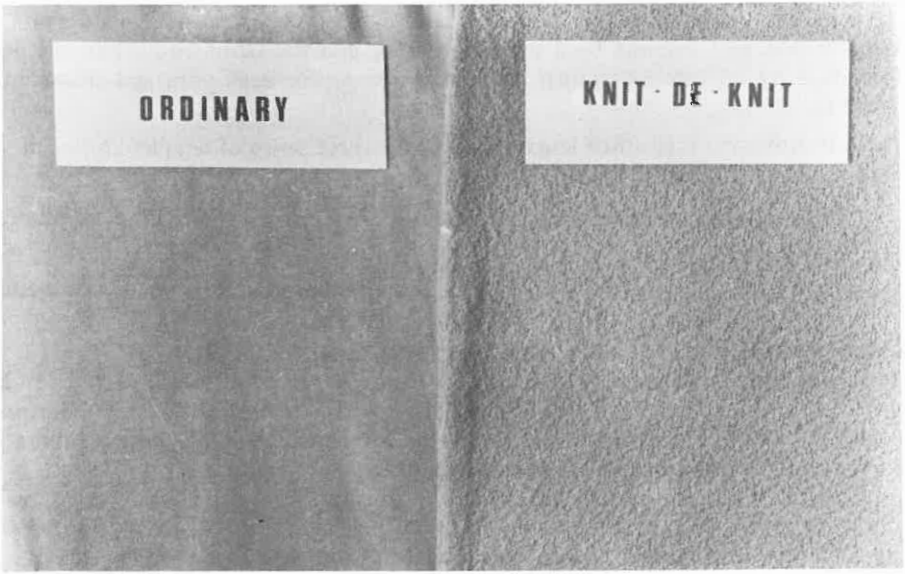

FIGURE 1

An illustration of a conventionally plain knitted fabric compared with a plain knit-de-knit fabric knitted at optimum knit-de-knit ratio

RESULTS AND DISCUSSION

The original stitch lengths (λ_o) to which the various tex yarns were knitted on the Lawson machine are shown in Table I.

TABLE I

LINEAR DENSITIES AND CORRESPONDING ORIGINAL STITCH LENGTHS (λ_o)

Linear density (tex)	Polyester/Cotton Blend (%)	Original stitch length (λ_o) in mm
R 32 tex/2	67/33	3,05
R 40 tex/2	67/33	3,30
2 ends of 26 tex knitted together	70/30	3,36

It was found that the optimum bouclé effect coupled with good fabric stability was best assessed by a subjective rating and the fabric considered best is identified by an asterisk against the respective λ_f for each yarn and shown in Table II.

Table II shows the final stitch lengths (λ_f) of the three series of samples knitted at corresponding machine settings.

Table III shows the relationship between λ_o and λ_f for achieving the optimum knit-de-knit effect.

It can be seen from Table III that the knit-de-knit ratio (β) $= \frac{\lambda_f}{\lambda_o}$ for optimum knit-de-knit effect is very nearly constant and averages 1,77.

If Munden's[7] equations are applied to these plain knit-de-knit fabrics and the $K_{(1-4)}$ values calculated, (see Tables IV, V and VI) to determine whether it is possible to predict the fabric dimensions after relaxation it becomes apparent that K_1 increases as the final stitch length (λ_f) increases.

Fig. 2 shows K_1 plotted against λ_f and illustrates the dependence of K_1 on stitch length λ_f. It can also be seen from Tables IV, V and VI that K_3 is fairly constant for all three yarns used, and therefore, the dependence of K_1 on λ_f is mainly due to variation in K_2 (lengthwise relaxation shrinkage). This indicates that the yarns are more free to collapse (retract) as the stitch length increases which could be expected.

TABLE II

FINAL STITCH LENGTH (l_f) IN MM OBTAINED AT CORRESPONDING MACHINE SETTINGS FOR EACH YARN

Machine Settings	67/33 Polyester/Cotton		70/30 Polyester/Cotton
	R 32 tex/2	R 40 tex/2	2 ends of 26 tex knitted yarn
+ 18			6,50
+ 17			6,45
+ 16			6,34
+ 15			6,29
+ 14		6,17	6,16
+ 13		6,07	6,06*
+ 12		6,02	6,01
+ 11		5,95	5,83
+ 10	5,79	5,75*	5,76
+ 9	5,70	5,65	5,70
+ 8	5,63	5,61	5,67
+ 7	5,56	5,54	5,58
+ 6	5,47	5,49	5,51
+ 5	5,43*	5,29	5,43
+ 4	5,38	5,25	5,41
+ 3	5,35	5,25	
+ 2	5,24	5,24	
+ 1	5,18	5,15	
0	5,08	5,02	
− 1	5,03		
− 2	4,86		
− 3	4,79		
− 4	4,63		

*Stitch length producing the best fabrics

TABLE III

RELATIONSHIP BETWEEN λ_o AND λ_f TO GIVE THE OPTIMUM KNIT-DE-KNIT EFFECT

Linear Density	λ_o (mm)	λ_f (mm)	Knit-de-knit ratio = β
R 32 tex/2	3,05	5,43	1,78
R 40 tex/2	3,30	5,75	1,74
2 ends of 26 tex knitted together	3,36	6,06	1,80

TABLE IV

DIMENSIONAL PROPERTIES OF PLAIN KNIT-DE-KNIT FABRICS KNITTED FROM R 32 TEX/2 YARNS

Wales per cm	Courses per cm	λ_f (mm)	K_1 (Cp cm x wp cm x $\lambda_f^2 \times 10^{-2}$)	K_2 (Cp cm x $\lambda_f \times 10^{-1}$)	K_3 (wp cm x $\lambda_f \times 10^{-1}$)	K_4 (K_2/K_3)
6,7	11,9	5,8	26,6	6,9	3,9	1,8
6,6	12,2	5,7	26,1	7,0	3,8	1,8
7,0	12,2	5,6	27,1	6,9	3,9	1,8
7,0	12,3	5,6	26,6	6,8	3,9	1,8
7,1	12,7	5,5	26,9	6,9	3,9	1,8
7,3	12,2	5,4	26,4	6,6	4,0	1,7
7,2	12,8	5,4	26,4	6,9	3,9	1,8
7,7	12,1	5,4	26,7	6,5	4,1	1,8
7,7	12,4	5,2	26,3	6,5	4,0	1,6
7,8	12,4	5,2	26,1	6,4	4,0	1,6
8,0	12,3	5,1	25,5	6,2	4,1	1,5
7,9	12,8	5,1	25,5	6,4	4,0	1,6
8,2	13,0	4,9	25,3	6,3	4,0	1,6
8,5	12,9	4,8	25,0	6,2	4,0	1,5
8,8	13,0	4,6	24,4	6,0	4,1	1,5

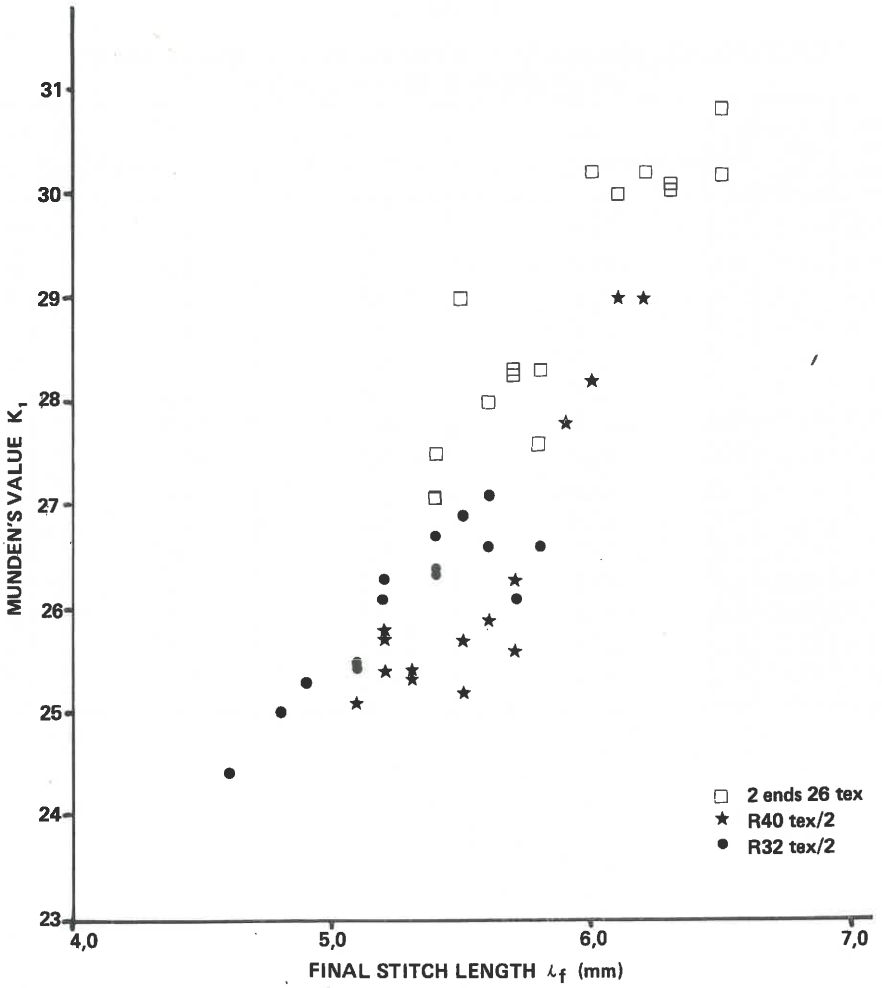

FIGURE 2

Graph showing Dependence of K_1 on Stitch Length l_f

TABLE V

DIMENSIONAL PROPERTIES OF PLAIN KNIT-DE-KNIT FABRICS KNITTED FROM R 40 TEX/2 YARNS

Wales per cm	Courses per cm	λ_f (mm)	K_1 (cp cm x wp cm x $\lambda_f^2 \times 10^{-2}$)	K_2 (Cp cm x $\lambda_f \times 10^{-1}$)	K_3 (wp cm x $\lambda_f \times 10^{-1}$)	K_4 (K_2/K_3)
6,6	11,5	6,2	29,0	7,1	4,1	1,7
6,6	11,9	6,1	29,0	7,2	4,0	1,8
6,8	11,5	6,0	28,2	6,9	4,1	1,7
6,9	11,4	5,9	27,8	6,8	4,1	1,6
7,1	11,2	5,7	26,3	6,5	4,1	1,6
7,0	11,4	5,7	25,6	6,4	4,0	1,6
7,1	11,7	5,6	25,9	6,5	4,0	1,7
7,3	11,2	5,5	25,2	6,2	4,1	1,5
7,4	11,5	5,5	25,7	6,3	4,1	1,6
7,5	12,1	5,3	25,4	6,4	3,9	1,6
7,7	12,0	5,2	25,4	6,3	4,0	1,6
7,6	12,0	5,3	25,4	6,3	4,0	1,6
7,8	12,0	5,2	25,7	6,3	4,1	1,6
7,9	12,2	5,2	25,8	6,3	4,1	1,5
8,1	12,1	5,1	25,1	6,1	4,1	1,5

TABLE VI

DIMENSIONAL PROPERTIES OF PLAIN KNIT-DE-KNIT FABRICS KNITTED FROM TWO ENDS OF 26 TEX YARN

Wales per cm	Courses per cm	l_f (mm)	K_1 (cp cm x wp cm x $l_f^2 \times 10^{-2}$)	K_2 (Cp cm x $l_f \times 10^{-1}$)	K_3 (wp cm x $l_f \times 10^{-1}$)	K_4 (K_2/K_3)
6,6	11,0	6,5	30,8	7,1	4,3	1,7
6,6	11,0	6,5	30,2	7,1	4,2	1,7
6,7	11,1	6,3	30,1	7,0	4,3	1,6
6,6	11,5	6,3	30,1	7,2	4,2	1,7
6,9	11,5	6,2	30,2	7,1	4,3	1,7
7,1	11,5	6,1	30,0	7,0	4,3	1,6
7,3	11,5	6,0	30,2	6,9	4,4	1,6
7,1	11,5	5,8	27,6	6,7	4,1	1,6
7,3	11,6	5,8	28,3	6,7	4,2	1,6
7,4	11,8	5,7	28,3	6,7	4,2	1,6
7,5	11,8	5,7	28,3	6,7	4,2	1,6
7,6	11,8	5,6	28,0	6,6	4,3	1,5
7,9	12,0	5,5	29,0	6,6	4,4	1,5
7,8	11,9	5,4	27,5	6,5	4,3	1,5
7,8	11,8	5,4	27,1	6,4	4,2	1,5

SUMMARY AND CONCLUSIONS

Knit-de-knit body blanks have been knitted at various stitch lengths from approximately 67/33 polyester/cotton knit-de-knit yarns, and by subjective evaluation it has been shown that a ratio β exists between the original stitch length (λ_o) and the final stitch length (λ_f) of 1,77 to give an optimum bouclé effect with reasonable dimensional stability.

It has also been shown that Munden's K_1 value for knit-de-knit fabrics is not a constant but depends upon the final stitch length (λ_f). K_3 is fairly constant and therefore the dependence of K_1 on λ_f is mainly due to the variation in K_2 (length-wise relaxation shrinkage), which indicates that the yarns are more free to collapse as the stitch length (λ_f) increases.

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THE USE OF PROPRIETARY NAMES

The fact that chemicals having proprietary names have been used in this investigation does not imply that SAWTRI recommends them or that there are not others which are as good or even better for the purposes mentioned.

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