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148

PRELIMINARY REPORT ON A POSSIBLE METHOD OF MANUFACTURING KNITTED FABRICS FROM WOOL-RICH BLENDS

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ABSTRACT

A technique for manufacturing double-jersey fabrics containing low percentages of a synthetic component, is proposed. With this technique, wool is plated onto both sides of a synthetic ground structure or "scrim". In this way the unique advantages of wool are combined with the more beneficial physical properties of the synthetic component. The resulting fabrics can be knitted with higher efficiency and will perform better during washing, than all-wool fabrics of equivalent weight and tightness.

KEY WORDS

Wool, synthetic filament, wool-rich blend, plating, polyamide, knitting performance, relaxation, washing, fabric setting.

INTRODUCTION

The decline in wool's share of the double-jersey market has been a source of major concern to wool producers and processors the world over. Although wool is much appreciated for some of its unequalled physiological[1], aesthetic and physical[2] properties, it would seem that the primary reasons for this decline are low yarn strength and fabric instability[3] in "wash and wear". By contrast, synthetic yarns are strong and by virtue of their thermo-plastic[4] nature, fabrics knitted thereof can subsequently be stabilised by a heat setting process, in order to impart so-called "easy care" properties to the fabric. Blends of wool and synthetic fibres in which the more important qualities of both fibre types complement each other should therefore prove suitable for many end-uses.

Some of the existing methods of blending textiles are the following:

Intimate blending:

Here the fibres are mixed in staple form during carding and combing.

Core-spinning[5]:

Here, yarns are spun with a synthetic filament core on the spinning machine. SAWTRI is currently investigating the behaviour of these yarns during knitting as well as the properties of fabrics knitted from them.

Feeder-blending[6]:

With this system, different yarn types are fed into a knitting machine, thus producing a blended fabric. This method has recently gained popularity in synthetic fabric production where filament yarns are feeder-blended with low percentages of spun yarns in order to obtain fabrics of the so-called "spun-look". On the other hand, this method can also be used to produce wool-rich fabrics by introducing filament yarns at some of the machine feeders. However, it is felt that this method is firstly not versatile enough to allow for low percentages synthetic content and secondly, the method will not improve knitting performance in general, because most feeders in the machine will still be knitting relatively low-strength, pure wool yarns.

It was for these reasons that a different approach to the production of double-jersey fabrics from wool-rich blends was decided on. This approach is based on the method of plating[7], as is often found in flat-bed knitting. In this way it is hoped to obtain a fabric of relatively low synthetic content in which the synthetic component, although aiding knitting performance and fabric behaviour during wash and wear, will be hidden by the wool on both sides of the fabric.

This report describes preliminary investigations into the feasibility of the method of plating as applied to the Punto-di-Roma structure.

EXPERIMENTAL

The knitting machine used was an 18 gauge, 30″ diameter Mellor Bromley 8 RD fitted with positive feed wheels of the conical type. All fabric samples were knitted in delayed timing. Two different counts of wool yarn were used viz. R23,5 tex ($^1/37$'s w.c.) dry-spun at SAWTRI and R28 tex ($^1/32$'s w.c.) obtained from a commercial spinner. These yarns were treated against felting shrinkage with 4½ *per cent* Dichloro-iso-cyanuric acid (DCCA), dyed to a dark shade and subsequently waxed with paraffin wax discs on a Schweiter cone winder prior to knitting. Polyamide flat filament yarns, having 13 individual filaments and a linear density of R44 d tex (40 denier), were used in conjunction with the R23,5 tex wool yarns for plating. Polyamide yarns were chosen because their dyeing properties[8] closely resemble those of wool.

1. *Plating Efficiency:*

For the purpose of this report, plating efficiency may be defined as the effectiveness with which the plating (wool) yarn covers or hides the ground (filament) yarn. Therefore, the R23,5 tex dyed wool yarn was used in combination with the R44 d tex undyed polyamide filament for judging plating efficiency subjectively by scrutinising the fabrics for spots where the white filament yarn was visible. Thus it was possible to pinpoint machine variables which impaired plating efficiency. These variables were notably the relative tensions and positions of the wool and filament yarns on entering the knitting feeders. Yarn position at the feeders was altered by using slightly modified feeders as shown in Fig. 1, while yarn tension was changed by feeding the wool and filament yarns over separate feed wheels. The yarn input tensions could thus be varied by altering the relative yarn speeds. The results are shown in Table I.

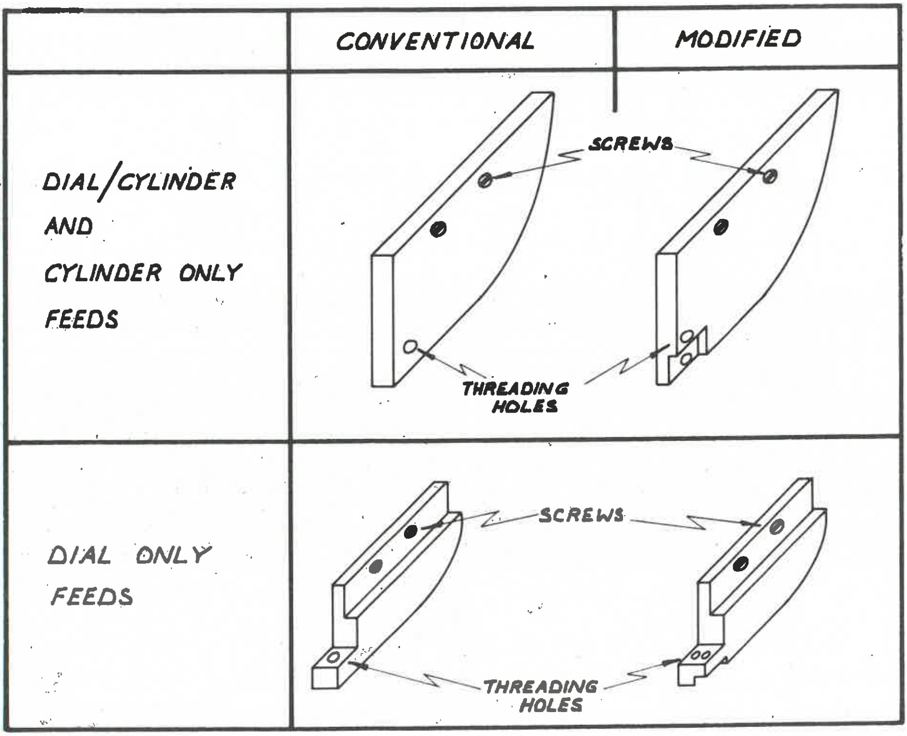

FIGURE 1

2. *Fabric Properties:*

Punto-di-Roma fabrics were knitted under the optimum conditions for plating as established in section 1, above. These fabrics were subsequently allowed to relax in a standard atmosphere (20°C, 65% R.H.) upon which they were steamed in an autoclave[9] for 20 minutes at 110°C. The fabrics were then tested for shrinkage according to the Australian Wool Board's washing specification[10] and for abrasion resistance on a Martindale Wear Tester. The results are given in Table II which also contains shrinkage results on a plated fabric treated with Synthappret LKF[11]

TABLE I

INFLUENCE OF WOOL AND FILAMENT INPUT TENSIONS ON PLATING EFFICIENCY

Input Tension (gms)		Plating Efficiency
Wool	Filament	
3,5	1,0	Poor
3,5	1,5	Fair
3,5	3,5	Good
3,5	6,0	Good
5,5	3,0	Fair
5,5	5,0	Good

3. *Knitting Performance:*

The knitting performance of a yarn can be assessed by counting the number of defects in a fabric knitted from it. In this report the knitting performance of yarns knitted together by the plating technique shown in Fig. 2, was evaluated against that of pure wool yarns. To do this, the all-wool R28 tex yarn was knitted to such a tightness as to cause holes to appear in the fabric. This yarn was subsequently replaced by the filament/wool combination (R44 d tex filament, R23,5 tex wool) and knitted to approximately the same fabric tightness. Further-

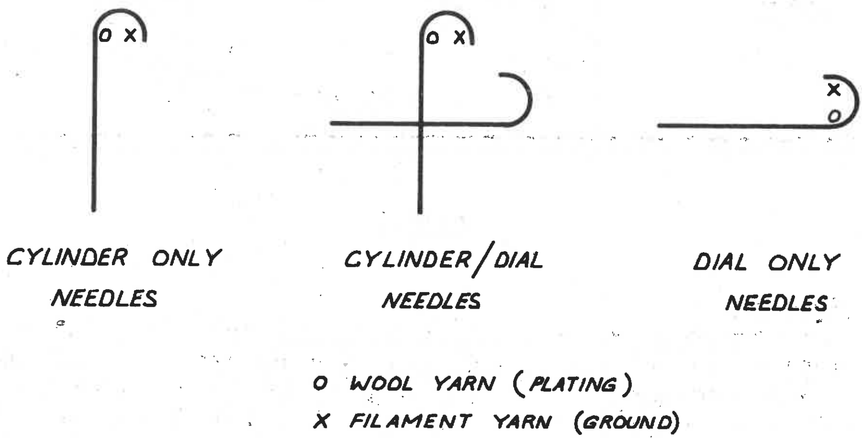

FIGURE 2

TABLE II

SHRINKAGE AND ABRASION RESISTANCE OF EXPERIMENTAL FABRICS

FABRIC TYPE		FABRIC TIGHTNESS	SHRINKAGE %				ABRASION RESISTANCE (MARTINDALE)
			After 3 min. wash*		Total Shrinkage*		% Weight loss after 10 000 cycles
			Length	Width	Length	Width	
PLATED	DCCA-Treated	Tight	1,5 1,3	3,1 3,3	3,8 2,8	4,8 5,0	2,55 3,06
		Slack	0,8 1,9	1,6 2,0	5,1 6,9	4,3 4,5	– –
	Synthappret Treated	Slack	2,5 2,5	-0,2 -0,6	2,3 2,8	0,2 1,75	– –
PURE WOOL	DCCA-Treated	Tight	1,6 2,2	4,4 3,2	5,1 6,1	7,1 6,0	4,00 4,05
		Slack	2,6 2,3	4,6 5,8	7,4 6,8	9,9 10,3	– –

*All fabrics washed according to Australian Wool Board wash specifications (See reference 10) more, in order to assess the effect of filament input tension on knitting performance, the filament yarns were again fed over separate feed wheels to obtain the desired input tension differences. As a result some of the blended fabrics were knitted slightly tighter than the all-wool control fabric. The relevent results are shown in Table III.

DISCUSSION OF RESULTS

During the evaluation of plating efficiency, it was soon apparent that the positioning of the wool and filament yarns in the needle hooks, was the primary factor influencing the plating efficiency. It was found that only when the yarns were positioned in the needle hooks as depicted in Fig. 2, did optimum plating efficiency result. This was accomplished by slightly modifying the feeders of the knitting machine to the forms shown in Fig. 1.

The comments in the last column of Table I suggest that the relative input tensions of the wool and filament yarns, also affected plating. It can be seen that low input tensions on the filament yarn should be avoided if efficient plating is required. However, it must be stated that the influence of tension was of little significance in comparison with that of yarn position.

Table II suggests that the relaxation shrinkage of the plated fabrics (with the polyamide filament as ground yarn) was almost entirely removed during autoclave setting and that total shrinkage during the Australian Wool Board washing test, was within specification. By contrast, the pure wool control fabrics performed worse during washing and the slacker structures often failed the washing test. It should also be pointed out that the plated fabrics exhibited remarkable stitch clarity and lack of fuzziness after washing as compared with the pure-wool samples. Of further interest is the fact that the plated fabrics treated with Synthappret, for which shrinkage results have been included in Table II, performed extremely well during washing.

TABLE III

EVALUATION OF KNITTING PERFORMANCE

Number of		Input Tension (gm)		No. of holes in	
Machine Feeds	Machine Revolutions	Wool	Filament	All-wool Fabric	Plated Fabric
4	2 000	3,5	–	54	–
4	2 000	3,5	1,0	–	0
4	2 000	3,5	3,5	–	0
4	2 000	3,5	10,0	–	0

From the results on the abrasion resistance of the fabrics which also appear in Table II, it can be seen that the percentage weight loss was lower than, that of the pure wool fabrics. Holes appeared in the all-wool fabric after 20 000 cycles but up to 50 000 cycles no holes had yet appeared in the plated fabrics.

The results in Table III suggest that knitting performance was improved markedly by the introduction of a thin filament yarn at each machine feed. This is probably not surprising considering the results of Table IV in which it is shown that the tensile strength of the wool/filament combination is approximately double that of a wool yarn of equivalent count. Furthermore, no effect of input tension differences between the filament and wool yarns on knitting performance could be established from the results in Table III.

TABLE IV

TENSILE STRENGTH OF EXPERIMENTAL YARNS

Yarn Type	Yarn Count		Approximate Breaking Load (gms) (Average of 100 breaks on USTER)
	Tex	w.c.	
Wool	23,5	1/36	153
Filament	4,4	–	184
Wool	28,0	1/32	184

CONCLUSIONS

The introduction of low percentages of polyamide flat filament into wool fabrics during knitting, seems to have a beneficial effect on the more important processing and end-commodity aspects of this traditional fibre. This preliminary report indicates that, by employing the plating technique described above, knitting performance as well as fabric performance in wash and wear, can be considerably improved while retaining the handle and aesthetic qualities which are unique to the wool fibre.

This investigation will be extended in the near future to encompass other types of double-knits with the emphasis on lighter fabrics from finer gauge machines. The possibility of using a textured filament as a ground yarn will also be looked into although, at the moment, it is felt that the use of flat filament is more attractive from a cost point of view.

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