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THE DESIGN AND PHYSICAL PROPERTIES OF CO-WE-NIT MEN'S OUTERWEAR FABRICS

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ABSTRACT

A new concept in designing colour-and-Co-we-nit effects is described and illustrated with samples. It is shown that combinations of two structures with colour patterning produce subtle check patterns. Specifications for wool-rich worsted suitings/trouserings are given and the physical properties of these Co-we-nit cloths are discussed.

KEY WORDS

Co-we-nit men's wear, wool-rich blends, polyester.

INTRODUCTION

During the past four years a number of articles on the Co-we-nit process have been published. Initially there was considerable speculation and interest with regard to how Co-we-nit would be accepted, and which sector of industry would use this new technique to the best advantage[1].

Originally, a number of worsted manufacturers acquired Co-we-nit machines with the intention of producing outerwear fabrics similar to woven worsteds but having the additional advantage of a quicker yarn to fabric conversion. This, however, did not meet with great success and very few firms diversified sufficiently to gain the full advantage of the machine's potentialities.

Initially the failure of some manufacturers to produce men's suitings by the Co-we-nit process, can possibly be attributed to their reluctance to utilise fibres other than those they were traditionally using in their production[2]. For example, the production of all-wool worsted suiting failed mainly because of the high fault rate experienced and the bulkiness of the fabric[3]. On the other hand the 100% polyester fabric lacked handle and fullness. It was therefore only logical that in order to produce a satisfactory worsted type cloth, the use of wool/synthetic blends became a necessity[4].

Several articles illustrated by some simple designs and cloths have described the Co-we-nit machine and the techniques used to produce these new structures[5–8]. One firm published details of woolmark fabrics produced on their Co-we-nit machines[9–11]. SAWTRI's contributions[12–18] emphasized the design potential of the Co-we-nit machine. Robinson[2] also reviewed SAWTRI's experience with Co-we-nit over a period of three years. Many adverse comments about this new

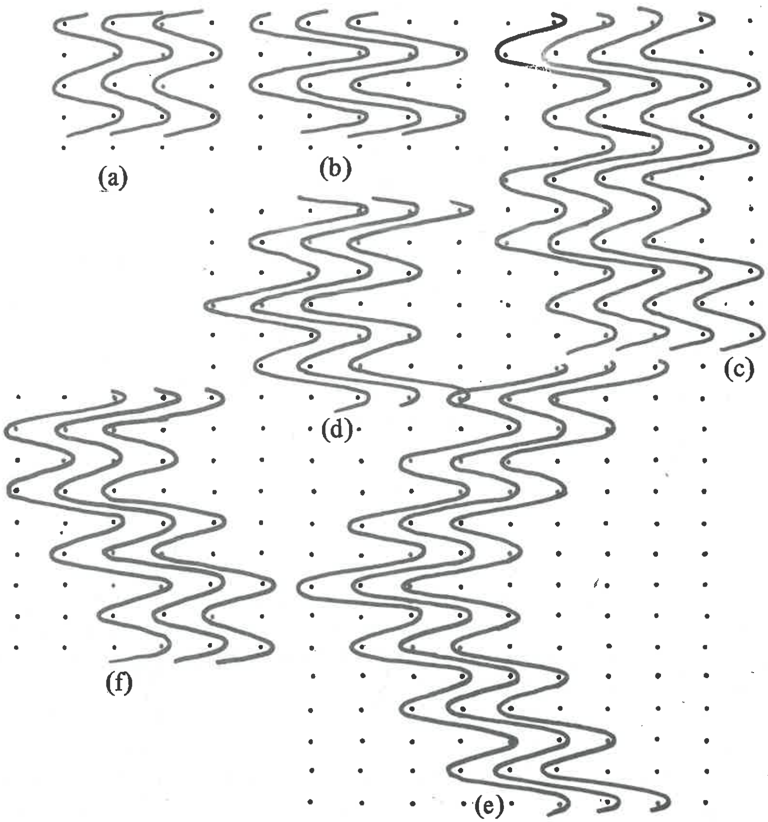


FIGURE 1

Various weft movements that can be used in Co-we-nit structures

technique were expressed[19, 20]. Nevertheless, in this report it will be shown that the Co-we-nit machine has great design potential in the field of men's outerwear.

Varied interlacing of the threads from bars 3 & 4 with the pseudo weft threads from bar 2 result in simple constructions as found in a woven cloth, e.g.: twill, matt, satin, leno, herringbone, diamond or spot. The scope, however, is somewhat limited, because the variety of interlacings is at most, only equivalent to that obtained by four heald shafts in a conventional loom. When varied weft movements are employed in conjunction with these structures the unique design potential of the Co-we-nit machine is exploited. An extensive range of new designs is possible which when combined with colour result in a multitude of "colour-and-Co-we-nit" effects. Fig. 1 shows several simple weft movements, (a) to (f), that can be readily employed.

Considering movement (a) in Fig. 1, as being the simplest weft movement, it can readily be seen that any of the other movements shown would give a fabric of higher weft density. To keep the cloth density constant the courses per centimetre have to be reduced which consequently results in a corresponding increase in production.

Because of the domination of warp ends in Co-we-nit structures there is a distinct tendency to produce stripes; however, by alternating two different structures, weft way stripes can be formed, which can be made to balance with coloured warp stripes to produce check patterns. This type of pattern closely resembles the classical Glen check produced by weaving.

To be suitable for men's apparel a fabric must have a smooth surface, must not be too lustrous, and it must be warm and comfortable. The cloth must be hard-wearing and must have a high resistance to wrinkling, or at least good wrinkling recovery, and also have a high resistance to pilling and snagging. The smooth surface can be achieved with fairly fine yarns at a reasonably high density, which *inter alia,* also affects the lustre of the fabric. Knitted fabrics, including warp knitted fabrics, generally have a good resistance to wrinkling whilst small float patterns do not snag or pill easily.

It will be shown in this report that all the required properties mentioned above are reasonably satisfied by wool-rich blend fabrics produced on the Co-we-nit machine.

EXPERIMENTAL

Design:

Six different weft movements (see Fig. 1) were used with six pattern chains (bars 3 and 4). Each structure was combined with 32 different colour combinations using two shades of yarn only, resulting in over 1 000 different colour-and-Co-we-nit effects. The six pattern chains (bars 3 and 4) are given in Appendix I. From the cloths produced four colour-and-Co-we-nit effects were matched to give a check design. This was done by either of two methods:

(a) Using a standard pattern chain (bars 3 and 4) and alternating two weft movements (bar 2), or

(b) Using a standard weft movement (bar 2) and alternating two pattern chains (bars 3 and 4).

In either case the changes in structure gave weft way stripes which then had to be balanced by warp way stripes produced by colour combinations only.

Fig. 2 shows a Co-we-nit diagram formed by method (a) and Fig. 3 shows a Co-we-nit diagram formed by method (b). The types of fabrics produced are illustrated by samples 1 and 2 respectively.

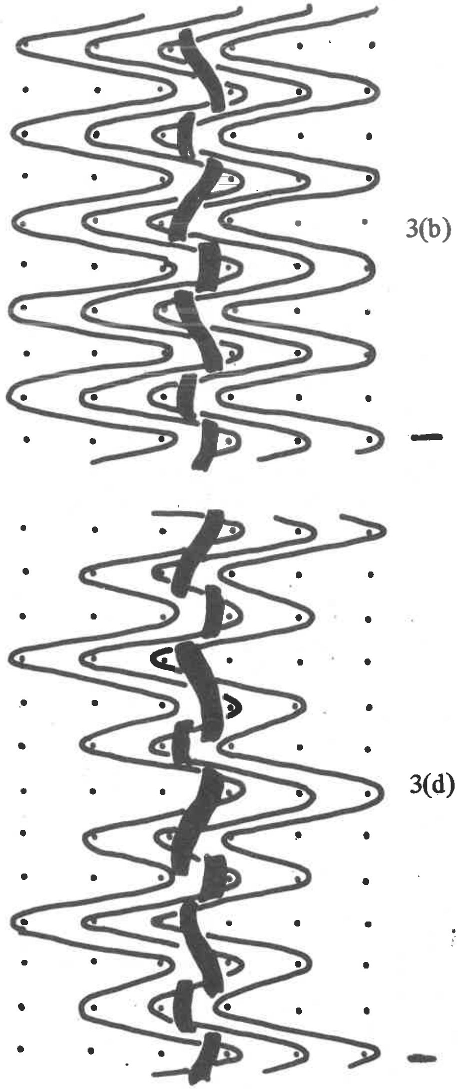
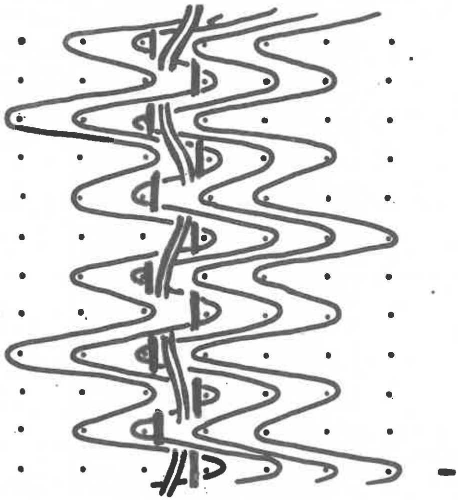


FIGURE 2

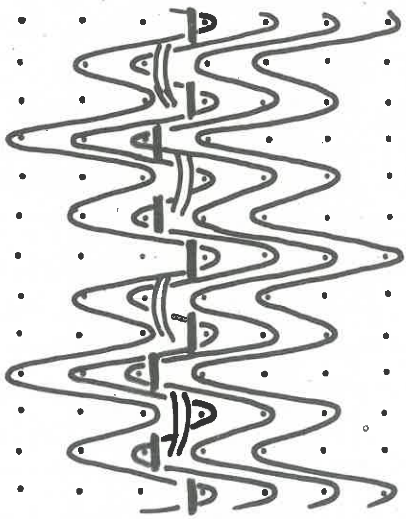
Weave diagram formed by method (a). Standard pattern chain 3 (see Appendix I) in combination with weft movements (b) and (d) (see Fig. 1)

Co-we-nit:

Experiments were carried out on a 75" 48/24 gg Co-we-nit RM 4FD machine using various wool/synthetic blends and all-wool yarns to determine a combination that would give an acceptable worsted cloth. From the results obtained during preliminary trials it was decided to use a synthetic filament yarn on Bar 1, a wool/



4(d)



5(d)

FIGURE 3

Weave diagram formed by method (b). Standard weft movement (d) (see Fig. 1) in combination with pattern chains 4 and 5 (see Appendix I)

polyester spun yarn on bar 2 and 100% wool worsted yarns on bars 3 and 4. An electric warp stop motion was adapted for use with bars 1 and 2.

It was found that using 110 decitex textured polyester in the pillar stitch (bar 1) resulted in a lower fault rate and a thinner fabric was obtained than if a spun yarn

TABLE I

RESULTS OF TESTS CONDUCTED ON CO-WE-NIT APPAREL

Test	Fabric 1 (Herring-bone)	Fabric 2 (Shadow Stripe)	Fabric 3 (Glen Check)	Fabric 4 (Blister Stripe)	Fabric 5 (Cord)	Range of Typical Values for Worsted Fabrics
Density g/m²	225	251	250	269	266	250
oz/lin yd	11,1	12,4	12,4	13,2	13,1	12,5
Thickness (mm)	0,696	0,803	0,821	0,858	0,734	–
Bending length (cm)						
Face up } Warp	1,76	1,84	1,97	2,20	2,68	–
Face down } Warp	2,37	2,43	2,59	3,17	2,02	
Face up } Weft	1,95	2,10	2,09	2,03	1,97	–
Face down } Weft	1,89	1,92	2,15	2,15	1,89	
Flexural Rigidity (mg-cm)						
Face up } Warp	122	156	191	288	511	150
Face down } Warp	300	360	434	858	219	- 350
Face up } Weft	167	232	228	225	202	
Face down } Weft	152	178	248	269	179	
Stoll Flat Abrasion Resistance (cycles to hole)	229	272	229	277	289	260 - 380
Martindale Abrasion: No. of cycles to hole	14 500	29 500	17 500	22 000	17 500	–
Breaking Strength (Kgf)						
Warp	38,1	48,4	27,5	31,1	33,2	–
Weft	25,1	23,4	24,7	30,5	28,2	
Deformability (%)						
Warp	0,02	0,12	0,45	0,22	0,05	1,0
Weft	1,63	1,52	1,43	1,04	0,38	- 2,0
FRL Wrinkling (mm)						
Warp	0,82	1,46	0,77	1,13	0,85	0,3
Weft	0,61	1,05	0,83	0,49	0,73	- 0,5
Shirley Crease Recovery Angle (degrees)						
face to face } Warp	151,8	146,9	152,0	154,4	118,1	135°
back to back } Warp	121,8	124,4	121,0	120,9	149,9	- 150°
face to face } Weft	136,1	134,6	135,9	144,8	136,1	
back to back } Weft	144,7	141,6	136,6	133,2	139,7	

had been used. A R42 Tex/2 85% wool/15% polyester yarn (bar 2) also ensured less yarn breakages. The R49 Tex/2 all-wool yarns in the filler (bars 3 and 4) gave an elegant appearance, handle, drape and fullness to the cloth. This combination of yarns made it possible to produce a medium weight fabric with a resultant blend of approximately 70% wool 30% polyester. Five fabrics are shown in Appendix II and the specifications for the fabrics are given in Appendix III.

Finishing:

The fabrics were scoured open width at low temperature and tentered. They were subsequently steamed, damped and brushed, cropped twice on the face and finally steamed, damped and brushed before autoclave decatising (vacuum steaming).

Testing:

Various physical properties of the cloths were determined by tests carried out under standard atmospheric conditions (65% R.H. and 20°C). The FRL wrinkle resistance and the crease recovery angle of the fabrics were measured at 75% R.H. and 26°C by methods described by Slinger[21]. The breaking strengths of the fabrics were determined on an Instron using the I.S.O. Tentative test method. The deformability was determined by a method described elsewhere[22]. The air permeability of the fabrics were determined on the WIRA Air permeameter at a pressure of 5 cm of water.

RESULTS AND DISCUSSION

Over 1 000 different colour and Co-we-nit fabrics were produced with the fabric mass range from 225 g/m^2 to 300 g/m^2. Production speeds ranged from 7,5 m/h to 12 m/h depending on the weft movement employed and the number of courses per centimetre. Generally speaking the structures were firm and stable with the exception of the structures obtained by combining 2(a) (pattern chain 2 and weft movement a), 3(a), 5(a) and 5(f) which were unsatisfactory. Fabrics 1 and 2 are examples of check designs which can be made using colour and Co-we-nit effects.

Table I shows the results obtained from the various tests conducted on the five fabrics.

From the density values shown in Table I the fabrics can be considered as *medium weight*. The fabrics were slightly thicker when compared with woven worsteds[23]. Their flexural rigidity was comparable to that of commercial light to medium weight woven fabrics.

The abrasive resistance of the fabrics as measured on the Stoll Quartermaster abrasion tester was lower than the abrasion resistance of equivalent woven fabrics[21]. Although the breaking strengths of the fabrics were rather low compared with wovens[24] it is felt that they would probably be strong enough for apparel wear (wearer trials are in progress). The mechanical stability was good and deformability was low. Tests showed the wrinkle resistance to be relatively poor as

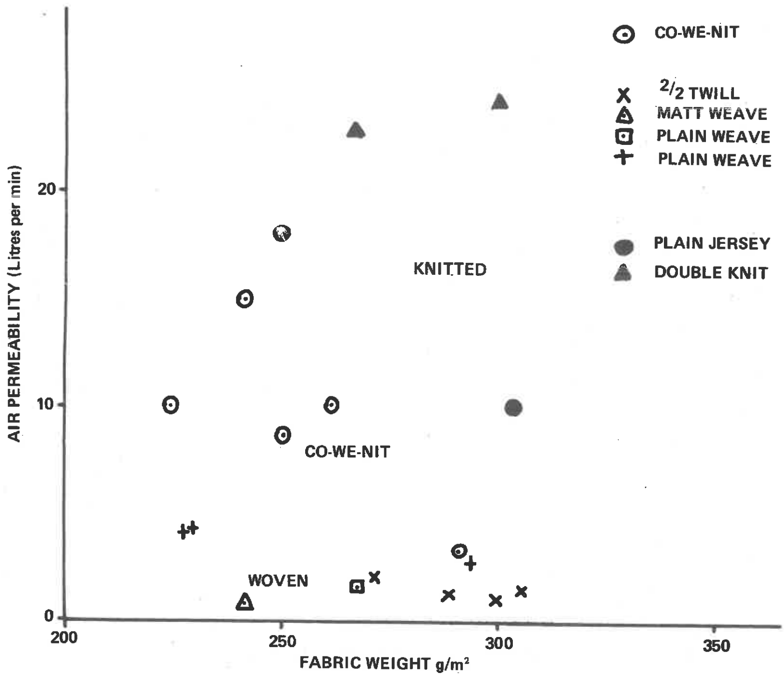


FIGURE 4

Comparison of air permeability of woven, Co-we-nit, and knitted fabrics

when compared with wool worsted woven as measured by the FRL test method, however, this low wrinkle resistance may not be noticeable because of the fancy patterns of the fabrics.

A graph showing the comparison of the porosity of the five Co-we-nit fabrics compared to other apparel is shown in Fig. 4.

The fabrics had a high air permeability when compared with woven cloths but less than that obtained with weft knitted suitings[21]. Whether or not air permeability will be a cause for customer complaint will depend on the climatic conditions.

Resistance to pilling was good because there were no pills observed after 1 000 rubbing cycles (Martindale test method). In addition to the above results there are a few practical points that have emerged from these investigations. Using the specified yarns a very low fault rate was achieved, hence, only burling was necessary, a factor which is important from a cost saving point of view.

In finishing, the shrinkage from the "grey" width was negligible, the fabrics were manufactured 155 cms to finish 150 cms.

SUMMARY AND CONCLUSIONS

By means of a few simple examples it has been shown that a great number of different structures can be produced on the Co-we-nit machine. In combination with colours many colour and Co-we-nit effects can be produced. By combining certain structures in blocks attractive "Glen checks" can be made.

The subtle differences of the various colour and Co-we-nit effects introduce a completely new concept in cloth design.

From the results of physical tests in the laboratory these fabrics appear to be satisfactory. The fabrics are not as strong as similar weighted wovens, but abrasion resistance is approximately equal. Pilling resistance was found to be good. Air permeability was higher than for wovens, but less than that of knitted fabrics. Draped and flexural rigidity were satisfactory and the percentage deformability was low. The resistance to wrinkling was slightly lower than that of wovens.

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APPENDIX I

PATTERN CHAINS FOR SIX SIMPLE CONSTRUCTIONS EMPLOYED IN OBTAINING VARIOUS COLOUR AND CO-WE-NIT EFFECTS

1.

Bar 3	Bar 4
4444	6644
4444	2244
6644	4444
*2244	*4444

2.

Bar 3	Bar 4
8844	4444
4444	0044
8844	4444
*4444	*0044

3.

Bar 3	Bar 4
4444	8844
0044	4444
4444	8844
4444	0044
8844	4444
*4444	*0044

4.

Bar 3	Bar 4
4444	8844
2244	4444
6644	4444
4444	0044
6644	4444
*2244	*4444

5.

Bar 3	Bar 4
8844	6644
4444	2244
8844	6644
0044	2244
4444	6644
*0044	*2244

*Start

6.

Bar 3	Bar 4
6644	4444
4444	2244
4444	6644
*2244	*4444

Using 2 ends per guide,
draw 2 miss 2
Suitable for twill, herringbone and diamond effects

APPENDIX III

FABRIC 1

Description: A two-tone, grey striped herringbone design with an unusual zig-zag effect blending in with the twill direction.

Weight :	335 g/150 (Finished)
Composition :	70% wool/30% polyester
Bar 1 take up 4,6:1	110 dtex polyester (text)
Bar 2 take up 5,1:1	R42 tex/2 85% wool/15% polyester
Bars 3 & 4 take up 1,1:1	R49 tex/2 100% wool

FABRIC 2

Description: A green and rust weft-way shadow stripe with a warp-way zig-zag.

Weight :	375 g/150 (Finished)
Composition :	85% wool/15% polyester
Bar 1 take up 4,6:1	110 dtex polyester (text)
Bar 2 take up 5,0:1	R49 tex/2 all wool and R42 tex/2 85% wool/15% polyester
Bars 3 & 4 take up 1,1:1	R49 tex/2 all wool

FABRIC 3

Description: A Glen check in two-tone rust and dark green.

Weight :	375 g/150 (Finished)
Composition :	85% wool/15% polyester
Bar 1 take up 5,0:1	110 dtex Polyester (text)
Bar 2 take up 5,8:1	R49 tex/2 100% wool and R42 tex/2 85% wool/15% polyester
Bars 3 & 4 take up 1,03:1	R49 tex/2 100% wool

FABRIC 4

Description: Blister stripe in green and chocolate brown.

Weight :	400 g/150 (Finished)
Composition :	85% wool/15% polyester
Bar 1 take up 5,0:1	110 dtex Polyester (text)
Bar 2 take up 6,0:1	R49 tex/2 100% wool and R42 tex/2 85% wool/15% polyester
Bars 3 & 4 take up 1,10:1	R49 tex/2 100% wool

FABRIC 5

Description: Two tone green cord.
Weight : 400 g/150
Composition : 80% wool/20% polyester

Bar 1 take up 5,0:1	110 dtex Polyester (text)
Bar 2 take up 6,5:1	R42 tex/2 85% wool/15% polyester
Bars 3 & 4 take up 1,05:1	R49 tex/2 100% wool

PATTERN CHAINS USED FOR FABRICS IN TABLE I

	Bar 1	Bar 2	Bar 3	Bar 4
FABRIC 1	0004	12 8 8 8	6644	4444
	*4440	4 8 8 8	4444	2244
		12 8 8 8	4444	6644
		4 8 8 8	*2244	*4444
		16 12 12 12		
		8 12 12 12		
		16 12 12 12		
		4 8 8 8		
		12 8 8 8		
		4 8 8 8		
		12 8 8 8		
		0 4 4 4		
		8 4 4 4		
		* 0 4 4 4		
FABRIC 2	0004	12 8 8 8	6644	4444
	*4440	4 8 8 8	4444	2244
		16 12 12 12	4444	6644
		8 12 12 12	*2244	*4444
		20 16 16 16		
		12 16 16 16		
		24 20 20 20		
		16 20 20 20		
		24 20 20 20		
		12 16 16 16		
		20 16 16 16		
		8 12 12 12		
		16 12 12 12		
		4 8 8 8		
		12 8 8 8		
		0 4 4 4		
		8 4 4 4		
		* 0 4 4 4		

FABRIC 3	0004	12	8	8	8	8844		6644	
	*4440	4	8	8	8	4444		2244	
		16	12	12	12	8844	x 7	6644	x 7
		4	8	8	8	0044		2244	
		12	8	8	8	4444		6644	
		* 0	4	4	4	0044		2244	
						4444		8844	
						2244		4444	
						6644	x 7	4444	x 7
						4444		0044	
						6644		4444	
						*2244		*4444	

FABRIC 4	0004	12	8	8	8	8844	6644
	*4440	4	8	8	8	4444	2244
		16	12	12	12	8844	6644
		4	8	8	8	0044	2244
		12	8	8	8	4444	6644
		* 0	4	4	4	*0044	*2244

FABRIC 5	0004	12	8	8	8	4444	8844
	*4440	* 0	4	4	4	*0044	*4444

*Start