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Part II: Shrinkproofed Wool in Wool/Polyester Blend Fabrics

by

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STUDIES OF SOME WOOL/POLYESTER WOVEN FABRICS

PART II: SHRINKPROOFED WOOL IN WOOL/POLYESTER BLEND FABRICS

*by MIRIAM SHILOH and R. I. SLINGER**

ABSTRACT

Two blends of dichloro-isocyanuarate (DCCA) treated wool tops and low pilling polyester fibres were prepared, in the ratio of 80/20 and 60/40 wool/polyester. From these blends lightweight suiting fabrics of two different structures and densities were woven. The mechanical properties of the fabrics were determined, their wrinkling performance measured and the results compared with those previously obtained from blends of untreated wool and polyester.

It was found that by increasing the polyester component the mechanical properties were improved, and that the twill fabrics had better wrinkle recovery than the plain weaves.

Comparing the results with those obtained for untreated wool and polyester blends, it was found that the DCCA treatment resulted in a considerable reduction in the tensile properties of the blends.

KEY WORDS

Wool – polyester – blends – mechanical properties – crease recovery angles – heat setting – autoclave decatising – bending – frictional couple – flexural rigidity – plain weave – twill weave – fabric geometry.

INTRODUCTION

A previous study of blends of wool and polyester in plain weave fabrics(1) showed that fabrics made from wool rich blends containing the low pilling polyester type gave a wrinkling performance which was superior to that of similar blends involving other types of polyester fibres. As a consequence of the previous results it was decided to investigate the properties of wool rich blends containing the low pilling polyester, in which the wool component was shrink resist treated before blending and also to compare the performance of a plain weave structure with other structures, such as twill weaves, in an attempt to achieve further improvements in the properties of the fabrics. An additional factor which was also considered was the density of the fabric and the effect of slight variations in density on the properties of the fabric with the main emphasis on wrinkling.

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* Deceased

EXPERIMENTAL

The experimental design chosen for this study included three factors, *viz.* structure, composition of blend, and fabric density, at two levels each, thereby providing eight fabric combinations. Three different finishing procedures were followed, so that the factorial design was of 3×2^3 fabrics.

Wool tops of 64's quality were shrinkproofed with DCCA [Fichlor 60s (Fisons)], following the procedure described by Swanepoel and Becker(2). The tops were treated in a solution containing 4,5% (on mass of fibres) DCCA and 10% Na_2SO_4, adjusted to pH 5,5 by the addition of acetic acid, achieving an exhaustion of 85%.

The treated tops were subsequently blended with Trevira type 350 (low-pilling), 75 mm 4-denier fibres. Blends of these polyester fibfes with 80% and 60% wool (by mass) respectively were prepared. It had been planned to produce yarns of R42 tex/$_2$ and R46 tex/$_2$ from each blend, with similar twist levels as used previously(1) and to weave fabrics of about 22 ends and picks per cm from both counts to achieve two fabric densities. The actual counts of the yarns in the finished fabrics, however, deviated from these nominal counts so that the differences in fabric density were accordingly only slight. The yarns were woven into plain weave and 2/2-twill fabrics.

Finishing

The eight fabrics were all two-way crabbed at the boil with a top roller pressure of 1 kgf/cm^2 and cooled in cold water. They were then scoured on the winch with 0,5 g/*l* Eriophon HD (Ciba Geigy A.G.) and 1 ml/*l* ammonia (25%) at 60°C for 30 min. This was followed by hot (45°C) and cold rinses during which the fabrics were treated with 1% acetic acid. After hydroextraction and tenter drying at 100°C for 1 min the fabrics were left overnight to reach normal regain.

After the above treatments the pieces were subdivided into three lots. One lot was autoclave decatised for 4 min at 2 kgf/cm^2 (KD series). The other two lots were heat-set in a tenter at 185°C for 30 seconds. One of the two lots was then autoclave decatised (HKD series), whereas with the other lot the latter treatment was omitted (H series). The fabrics, being of insufficient length (5–8 metres) were neither steamed, brushed, nor cropped.

For the sake of comparison, fabric samples prepared from low pilling polyester fibres blended with 80% and 60% wool, and the 100% wool fabric samples, which were tested in the previous study(1), were also subjected to the same DCCA treatment as that given the tops in the present study.

Test Procedures

The properties of the fabrics were measured following the same test procedures as described in Part I of this study(1). In addition, the Flex abrasion of the fabrics was measured on the Stoll Abrasion Tester, and the drape coefficient determined on the Cusick Drape Tester(3).

RESULTS AND DISCUSSION

The mean results of the mechanical properties of the 24 fabrics are presented in Table I, while those of the bending and wrinkling tests are presented in Table II. The analyses of variance of the results are presented in Tables III and IV.

Density

The fabrics were divided into two groups – one of low and one of high density, according to the experiment as planned. The density could not be correlated with the yarn count, due to finishing which seemed to cause larger variations in density than did the yarn counts. The higher density group was only 10% heavier than the lighter weight fabric, the twill fabrics (which usually shrink more from loom state to finished state) being heavier than the plain weave fabrics. Composition had no effect on the density.

Thickness

As could be expected, structure had the most significant effect on fabric thickness, the twill fabrics being about 20% thicker than the plain weave fabrics owing to the effect of floating yarns. The significant effect of finishing was that the fabrics which had been heat-set were considerably thicker than those which had been autoclave decatised, (the mean thickness values in mm were : 0,51 for the H series, 0,47 for the HKD series and 0,41 for the KD series). Thickness was also slightly higher in the case of the higher density fabrics, probably as a result of the higher yarn counts.

Air permeability and compactness

The high density fabrics had lower air permeability values than the low density fabrics, as would be expected, and the plain weave fabrics lower values than the twill fabrics. Air permeability increased with a decrease in the wool component.

When the cover factors (Kc), which are related to the compactness of the fabrics, were compared with fabric density (D) and thickness (T), it was found that:

$$K_c = 18{,}61 + 0{,}02\,D \; (r = 0{,}54, \; t = 3{,}0, \; n = 24)$$

$$K_c = 20{,}31 + 5{,}77\,T \; (r = 0{,}68, \; t = 4{,}4, \; n = 24),$$

these linear correlations were significant at the 0,1% level of confidence. The relationship between K_c and air permeability, however, was not found to be significant.

Tensile Properties

Similarly to the trends reported in Part I of this study, the bursting strength results in the present tests were correlated with the breaking strength results

TABLE I

MECHANICAL PROPERTIES OF FABRICS

Nominal Density & Yarn Count	Actual Yarn Count (Tex)	Composition	Structure	Finishing	Density (g/m²)	Picks & Ends (cm⁻¹)	Cover(*) Factor	Thickness (mm)	Air perme-ability (**)	Bursting Strength (kgf/cm²)	Breaking Strength			Strength Efficiency (%)	Extension at Break (%) (W+F)/2	Flex Abrasion (W+F)/2 (Cycles)
											(Kgf)		(gf/tex)			
											Warp	Weft	Mean			
Low (R42 Tex)	45,3	80/20 wool/polyester	Plain	H	205	23,2 × 21,7	22,7	0,44	8,0	10,8	46,7	44,8	9,4	57,7	25,1	618
				KD	200	23,6 × 21,3	22,7	0,37	8,1	10,5	46,3	44,0	8,8	54,0	24,3	631
				HKD	205	24,0 × 22,4	23,2	0,40	7,7	10,7	46,1	43,8	8,4	51,5	24,4	520
	39,4		Twill	H	209	24,4 × 24,0	22,8	0,46	10,1	12,0	46,0	47,1	9,6	58,9	21,3	937
				KD	206	25,2 × 23,2	22,8	0,46	10,3	12,4	51,9	44,8	10,0	61,4	21,3	970
				HKD	215	24,8 × 24,0	22,9	0,48	9,7	12,2	47,5	45,5	9,5	58,3	20,3	840
	43,5	60/40 wool/polyester	Plain	H	208	22,8 × 22,8	22,7	0,47	7,8	13,1	55,9	67,6	12,2	64,2	23,0	1048
				KD	192	23,2 × 21,3	22,3	0,37	10,8	13,4	57,3	61,7	12,1	63,7	22,3	1019
				HKD	203	22,4 × 22,8	22,6	0,41	10,3	12,5	56,4	56,7	11,3	59,5	22,7	822
	46,6		Twill	H	222	24,0 × 24,4	23,9	0,58	12,6	15,3	59,7	70,2	11,3	59,5	23,7	2178
				KD	203	24,4 × 22,4	23,5	0,42	12,0	15,0	65,8	63,6	11,7	61,6	21,4	1826
				HKD	218	24,0 × 24,0	23,8	0,51	11,1	15,1	60,0	71,8	11,6	61,1	21,2	1590
High (R46 Tex)	44,8	80/20 wool/polyester	Plain	H	224	23,6 × 20,9	22,5	0,47	6,2	11,1	51,7	47,1	9,8	60,1	27,5	931
				KD	211	23,6 × 20,9	22,5	0,40	7,1	11,5	52,6	42,9	9,4	57,7	26,3	805
				HKD	221	23,2 × 20,9	22,4	0,43	6,4	11,3	49,8	47,4	9,7	59,5	25,4	742
	43,0		Twill	H	246	24,4 × 24,0	23,4	0,58	9,2	13,2	53,6	55,3	10,3	63,2	21,9	1390
				KD	237	25,2 × 22,8	23,3	0,47	5,0	12,5	53,8	49,6	9,9	60,7	22,1	1373
				HKD	236	25,2 × 24,0	23,6	0,52	8,5	13,0	51,4	52,7	9,7	59,5	20,9	1097
	42,8	60/40 wool/polyester	Plain	H	219	23,6 × 21,7	22,5	0,47	7,6	14,0	67,5	65,1	13,5	71,1	23,7	1113
				KD	209	23,6 × 20,5	22,1	0,38	9,0	12,2	70,9	63,2	14,0	73,7	24,2	1155
				HKD	226	23,2 × 21,7	22,3	0,44	8,0	14,1	69,6	70,8	14,4	75,8	25,9	1106
	45,3		Twill	H	243	24,0 × 24,4	23,7	0,61	10,1	17,1	71,1	76,2	13,2	69,5	21,4	1837
				KD	229	24,8 × 23,2	23,6	0,43	5,9	16,0	72,0	67,4	12,6	66,3	20,8	2054
				HKD	242	24,0 × 24,4	23,7	0,54	9,0	16,4	70,6	76,7	13,2	69,5	20,5	2048

* Based on yarn counts in finished fabrics

** In cm³ per sec. per cm² at 1 cm water pressure

TABLE II

BENDING AND WRINKLING OF FABRICS

Nominal Density & Yarn Count	Actual Yarn Count (Tex)	Composition	Structure	Finishing	Bending Length (cm)		Flexural Rigidity, (mgf cm^2 per cm)	Owen's bending Test Mean Warp & Weft			Crease Recovery Anlges (W + F)		Area Shrinkage (%) 48 min
					Warp	Weft		Mo (mgf cm/cm)	B (mgf cm^2/cm)	Mo/B (cm $^{-1}$)	Shirley (75% R.H.)	AATCC (65% R.H.)	
Low (R42 Tex Yarns)	45,3	80/20 wool/polyester	Plain	H	1,83	1,82	125	16,0	76,7	0,21	243	310	2,6
				KD	1,92	1,81	130	14,5	78,0	0,18	245	314	2,6
				HKD	1,79	1,81	119	15,0	78,2	0,19	251	319	2,6
	39,4		Twill	H	1,71	1,78	109	15,7	75,2	0,21	276	328	3,1
				KD	1,83	1,75	115	13,0	71,4	0,18	273	325	2,6
				HKD	1,78	1,81	118	15,8	70,7	0,23	277	323	2,4
	43,5	60/40 wool/polyester	Plain	H	1,80	2,00	142	15,6	82,8	0,19	266	318	1,3
				KD	1,93	1,83	126	16,1	71,7	0,22	260	317	1,9
				HKD	1,76	1,86	120	13,5	75,3	0,18	265	320	1,1
	46,6		Twill	H	1,80	1,84	134	23,9	92,9	0,26	297	326	1,3
				KD	1,88	1,76	123	14,7	74,4	0,20	291	328	2,2
				HKD	1,75	1,89	131	16,9	80,9	0,21	291	328	1,1
High (R46 Tex Yarns)	44,8	80/20 wool/polyester	Plain	H	1,79	1,73	122	15,5	80,0	0,19	247	320	3,0
				KD	1,81	1,73	117	13,9	74,4	0,19	241	321	3,2
				HKD	1,76	1,74	118	12,9	73,9	0,17	247	320	2,6
	43,0		Twill	H	1,78	1,78	138	23,8	85,5	0,28	276	326	3,6
				KD	1,85	1,77	141	20,1	91,8	0,22	269	326	2,6
				HKD	1,74	1,76	127	15,2	81,5	0,19	284	326	3,7
	42,8	60/40 wool/polyester	Plain	H	1,89	1,96	156	21,8	90,1	0,24	245	316	0,8
				KD	2,03	1,95	165	18,0	86,4	0,21	248	313	1,0
				HKD	1,80	1,91	144	12,6	77,5	0,16	251	318	1,1
	45,3		Twill	H	1,82	1,91	158	26,3	108,7	0,24	282	324	1,6
				KD	1,94	1,81	152	16,5	88,4	0,19	274	320	1,6
				HKD	1,83	1,86	152	18,1	92,1	0,20	284	328	0,8

(r = 0,71, t = 4,7, significant at the 0,1% level). In both cases, breaking strength increased most significantly with increasing amounts of polyester (0,1% level), and also with an increase in the density of the fabrics (1% level). The bursting strength results, however, showed the twill fabrics to be much stronger than the plain weaves Both the warp and weft breaking strength results taken separately, as well as their means, did not show any significant difference between the two structures. This difference between the tests is due to the different mechanism of breakage which occurs in the multidirectional loading of twill fabrics in the bursting test. Significant interactions between composition and structure, and composition and density in the breaking strength tests show that the contribution of the wool and polyester components to the strength of the fabric is of a complex nature, depending upon yarn and fabric geometry. The finishing procedures had no significant effect on the tensile test results, as was also the case with the results of the untreated wool blends. The efficiency of the transfer of strength from fibre to fabric also improved with an increase in polyester component, as well as with an increase in fabric density (at the 0,1% level). The results, therefore, followed the same trends as those of the breaking strength tests.

Extension-at-break varied significantly with structure, that of the plain weave fabrics being higher than that of the twills. Accordingly, when the toughness values were calculated, the plain weave fabrics were found to be associated with significantly higher toughness values (see Figure 1). The toughness values (not shown in Table I) were also compared with strength efficiency and a highly significant correlation was obtained between these results, (r = 0,85, t = 7,5, n = 24).

The results of the flex abrasion tests show that the twill fabrics were about 70% more resistant to flex abrasion than the plain weave fabrics. The resistance increased rapidly with an increase in polyester content and, also, with fabric density. The effect of finishing was not pronounced, the HKD treatment causing only a slight decrease in the resistance to flex abrasion.

Bending and Wrinkling:

It was observed that the appearance of all the fabrics after 48 min Cubex washing test was very acceptable – all rated better than the three dimensional replica No. 5 of the AATCC rating procedure(4). Thus, it was not necessary to evaluate their wrinkle severity index(5). The area shrinkage values were all low, with an average shrinkage of 2,9% for the 80/20 wool/polyester blends, which improved further in the 60/40 wool/polyester blends to about 1,3%.

The flexural rigidity of the fabrics also increased with an increase in polyester content (see Part I), and with fabric density, while the finishing treatments and the structure had no significant effect on the results. In the flexural rigidity results, as obtained by Owen's method(1), trends for twill fabrics to be slightly stiffer and for autoclave decatising finishing treatments to decrease the stiffness, were observed.

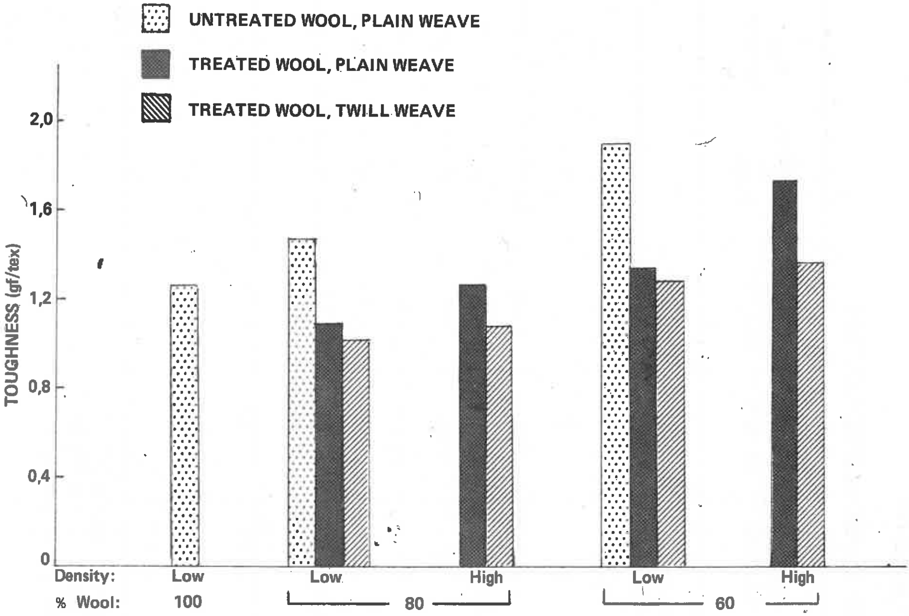

FIGURE 1

Toughness of blend fabrics

The frictional couple was not affected by fabric density and composition, while autoclave decatising had reduced this property as was previously found$^{(1)}$.

Two sets of results were obtained from the measurements of the crease recovery angles, under two different sets of atmospheric conditions. In both tests structure had the most significant effect, with the twill fabrics giving higher crease recovery angles in all cases. At 65% R.H. and 20°C, the recovery angles were not significantly affected either by fabric density, by the finishing procedures or by the different percentages of wool in the blends. On the other hand, under conditions of higher humidity (75% R.H., 27°C), these effects became most significant : crease recovery increased with an increase in polyester content, but decreased with an increase in fabric density and turned out to be best in the fabrics which were both heat-set and autoclave decatised (HKD series).

The results of the drape tests (which do not appear in Table II) were found to be correlated with the results of the bending length tests, (r = 0,63, t = 3,8, n = 24), and they were also significantly lower (at the 0,1% level) in the twill fabrics but increased slightly (5% level) with an increase in polyester content.

TABLE III

ANALYSES OF MECHANICAL PROPERTIES

Source of Variance	d.f.	Density	Thickness	Air Perme-ability	Bursting Strength	Breaking Strength	Strength Efficiency	Extension at Break	Flex Abrasion
					'F' Values				
Density	1	177,7***	8,0*	15,9**	13,1**	59,3***	56,0***	5,7*	20,0***
Finishing	2	19,2***	28,9***	0,2	0,8	0,5	0,7	2,0	4,0*
Structure	1	88,2***	56,6***	6,0*	110,8***	0,1	0,0	89,9***	165,2***
Composition	1	0,0	1,4	7,1*	190,9***	417,4***	85,6***	6,2*	136,8***
D X S	1	10,8**	1,0	2,2	1,0	3,6	3,7	10,2**	0,2
D X C	1	0,3	1,2	0,3	0,1	18,0***	13,9	1,7	2,8
S X C	1	0,7	0,6	0,1	7,8	17,0***	17,5***	9,6**	24,0***
E.M.S.		13,78	0,014	1,67	0,23	0,14	4,45	13,91	15537
Means of 24 Fabrics		218	0,46	8,8	13,2	11,1	62,4	23,0	1194
95% Confidence Limits		± 2	±0,01	±0,5	±0,2	±0,2	±0,9	±0,4	± 53

* – Denotes significance at the 5% level
** – Denotes significance at the 1% level
*** – Denotes significance at the 0,1% level

TABLE IV

ANALYSES OF BENDING PROPERTIES

Source of Variance	d.f.	Area Shrinkage	Flexural Rigidity	Frictional Couple	Owen's Flexural Rigidity	Crease Recovery Angle R.H. :	
						75%	65%
				'F' Values			
Density	1	0,2	27,5***	3,4	16,5**	32,6***	0,0
Finishing	2	1,0	1,7	7,6**	5,5*	7,9**	1,8
Structure	1	2,1	0,1	7,1*	7,4*	573,8***	70,8***
Composition	1	87,9***	35,07***	3,1	11,1**	67,3***	0,0
D X S	1	0,6	4,4	1,5	6,3	1,0	2,2
D X C	1	6,0*	7,7*	0,0	1,3	31,1***	9,8**
S X C	1	0,0	0,3	0,1	2,4	0,0	0,0
E.M.S.		0,15	1391,18	161,11	490,71	154,87	128,17
Mean of 24 Fabrics		2,1	133	16,9	81,6	266	321
95% Confidence Limits		±0,2	± 4	±1,2	± 2,3	± 2	±1

* – Denotes Significance at the 5% level
** – Denotes Significance at the 1% level
*** – Denotes Significance at the 0,1% level

COMPARISON BETWEEN PLAIN WEAVES OF TREATED AND UNTREATED WOOL IN BLENDS WITH LOW PILLING POLYESTER FIBRES

It was now possible to compare some of the present results with those of the previous study, where only plain weave untreated fabrics had been available. It should be noted, however, that the present fabrics were neither steamed, brushed nor cropped, while the blends of the untreated wool had been given these treatments, but it was assumed that only minor differences in fabric properties could be attributed to these treatments. The comparison is shown in Table V, which includes some results obtained on the pure wool and 80/20, 60/40 blends, "D" and "K" finished, and the present results from the plain weave fabrics in the "H" and "KD" finishing series, which are similar to the former "D" and "K" treatments. The higher density fabrics were also included as these were only slightly heavier than those of low density.

From the results of the breaking strength tests (which are linearly related to the bursting strength results for the plain weave fabrics) it is obvious that strength increased with an increase in polyester content, in both the *untreated* and the *treated* wool blends. Assuming that each component in the blend contributes its share to the strength of the fabric independently, the approximated strength of the polyester component can be calculated from the results obtained from the pure wool fabric and those from the blends. This will be equal to 25 gf/tex, the breaking strength of the polyester fibres being slightly higher i.e. 26,5 gf/tex. By introducing this value into the results from the blends with the treated wool, an estimated average breaking strength of 4,2 gf/tex for the *treated* wool component can be obtained. This value, when compared with the untreated wool, shows a strength loss of nearly 50%.

Single fibre breaking strength tests were then carried out on wool fibres drawn from the treated and untreated fabrics. No significant difference, however, was found between the results. An explanation for the apparent loss in strength of the treated fabrics in comparison with the untreated could not be readily given.

When the fabrics which were DCCA treated in *fabric form,* after having been finished, were tested, it was found that their flex abrasion and bursting strength test results did not show any significant loss compared with the untreated fabrics.

Table V includes some results of the flex abrasion tests which were not presented previously for the untreated wool blends. When these results are compared with those of the blends incorporating *treated wool* (treated in tops form), considerable losses can be observed. Similar calculations can be made as has already been done for the breaking strength tests. Flex abrasion also increased with an increase in the polyester content in both series of tests. Assuming once again, that each component of the blend acts independently of each other in the flex abrasion test, the loss in abrasion resistance in the wool component due to the DCCA treatment can be estimated as follows: the approximated value for the untreated wool is 1 000 cycles (introducing the mean value of "D" and "K"), and an estimated value

TABLE V

COMPARISONS BETWEEN PLAIN WEAVES OF TREATED AND UNTREATED WOOL IN BLENDS WITH LP POLYESTER FIBRES

Wool Tops	Density	Composition (% wool)	Finishing	Density (g/m^2)	Cover Factor	Air Permeability	Bursting Strength (Kgf/cm^2)	Breaking Strength (gf/tex)	Strength Efficiency (%)	Flex Abrasion (cycles)	Flexural rigidity (mgf^2 cm^2/cm)	Area Shrinkage 48 min (%)	Crease Recovery Angle, R.H.		Frictional Couple (mgf cm/cm)
													75%	65%	
Untreated	Low	100	D	191	20,6	10,3	9,2	8,0	57,4	1248	78	12,1	259	302	8,5
			K	192	21,4	8,7	8,4	7,3	52,3	731	83	9,3	274	319	8,3
		80	D	204	22,0	7,6	11,8	11,2	67,8	1417	111	2,5	268	310	15,2
			K	203	22,2	10,0	11,2	10,8	65,2	1230	103	2,0	273	313	9,2
		60	D	199	21,9	9,1	13,4	15,6	82,1	1583	131	2,0	280	314	19,7
			K	198	22,1	12,7	14,2	14,7	77,5	1445	104	0	282	309	11,5
Treated	Low	80	H	205	22,7	8,0	10,8	9,4	57,7	618	125	2,6	243	310	16,0
			KD	200	22,7	8,1	10,5	8,8	54,0	631	130	2,6	245	314	14,5
		60	H	208	22,7	7,8	13,1	12,2	64,2	1048	142	1,3	266	318	15,6
			KD	192	22,3	10,8	13,4	12,1	63,7	1019	126	1,9	260	317	16,1
Treated	High	80	H	224	22,5	6,2	11,1	9,8	60,1	931	122	3,0	247	320	15,5
			KD	211	22,5	7,1	11,5	9,4	57,7	805	117	3,2	241	321	13,9
		60	H	219	22,5	7,6	14,0	13,5	71,1	1113	156	0,8	245	316	21,8
			KD	209	22,1	9,0	12,2	14,0	73,7	1115	165	1,0	248	313	18,0

of 2 500 cycles for the polyester component can be obtained from the results of the blends. Introducing the latter value into the results from the treated blends an estimate of 300 cycles is obtained for the treated wool component. This low value shows a loss in abrasion resistance of about 70% compared with the original wool, in which the loss is even higher than that which occurred in the results of the breaking strength tests. It is therefore possible that the assumption of independent performance of the components can not be justified, and the abrasion resistance of the fabric would probably depend more strongly upon the weakest component. If, however, fabrics are treated after finishing no such an adverse effect can be observed.

The differences in toughness of the treated and untreated blends in plain weaves are also shown in Figure 1, from which it is inferred that the treated wool was inferior to the untreated wool, while the twill structures were inferior to the plain weaves in this respect.

The strength efficiency in the treated wool blends was also lower than that obtained in the case of the untreated wool blends, while the flexural rigidity decreased significantly.

Crease recovery angles under *standard* atmospheric conditions were slightly improved by the DCCA treatment, while the reverse occurred at higher humidity conditions. In the latter case, the untreated wool blends were significantly better than the treated ones. The frictional couples were also lower in the untreated wool blends, indicating a better level of setting in these fabrics. Autoclave decatising did not reduce the frictional couples in the treated wool blends to the same extent as it did in the untreated blends.

CONCLUSIONS

Slight increases in fabric density significantly affected some fabric properties: thickness increased, though mainly through increased yarn counts; air permeability decreased owing to increased compactness; strength and strength efficiency as well as the resistance to flex abrasion, increased, the flexural rigidity increased and the crease recovery at high humidity conditions became slightly worse.

It was found that the density and thickness of the twill fabrics increased by finishing but their air permeability was still higher than that of the plain weave fabrics. While the twill fabrics were much more resistant to flex abrasion and bursting strength, they had a lower extension-at-break than the plain weave fabrics in the tensile tests, resulting in reduced toughness. The wrinkling performance of the twill fabrics, as reflected by the results of both crease recovery tests, was superior to that of the plain weave fabrics.

Differences between the blends made from 80% wool or 60% wool and the low pilling polyester fibres were most pronounced in the mechanical performance of the blends which improved significantly with an increase in the percentage of polyester i.e. improved resistance to flex abrasion, tensile strength, bursting strength and strength efficiency. A significant decrease in area shrinkage also occurred when the polyester component was increased, together with an improvement in crease recovery under conditions of high humidity.

Heat-setting, autoclave decatising and the combination of both these finishing treatments did not effect significant differences in mechanical properties and only the flex abrasion was slightly reduced by the combined treatments. Both fabric density and thickness were lowest after autoclave decatising compared with heat-setting or the combined treatment. Autoclave decatising did not improve the crease recovery angles, neither did it have any effect on area shrinkage. The frictional couples of the autoclave decatised fabrics were lower than those of the heat-set fabrics, but the differences were much smaller than those found for the blends with *untreated* wool.

Comparing the blends which contain the DCCA-treated wool with similar blends containing untreated wool it can be concluded that the appearance after washing of both sets of fabrics was acceptable and that the *treated* wool did not produce fabrics with further improved wrinkling performance. In view of the high loss in tensile properties which occurred in the blends with the treated wool, it does not seem as though the treatment in top form is of any advantage in wool/polyester blends. DCCA treatment of *pure* wool fabrics may, however, be of advantage as far as wrinkling and shrinkage are concerned, but in view of the deterioration in mechanical properties, a much milder treatment should be considered. DCCA treatment of blends may be advantageous in *fabric form*, after a certain extent of setting has already taken place.

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