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A Comparison of Fibre, Yarn and Fabric Properties of an Imported 64's Merino, a South African 64's Merino and a 50/50 Blend

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A COMPARISON OF FIBRE, YARN AND FABRIC PROPERTIES OF AN IMPORTED 64's MERINO, A SOUTH AFRICAN 64's MERINO AND A 50/50 BLEND

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ABSTRACT

The performance and physical properties of fibre, yarn and fabric produced from a 64's quality imported merino wool, a Cape Merino 64's wool and a 50/50 blend of these has been investigated. The two raw wools were closely matched, the only significant difference being the higher CV of staple crimp of the imported wool. Differences in processing performance were slight, and there were no significant differences in yarn properties, performance during preparation or weaving. All three fabrics had virtually identical properties with the exception of wrinkle resistance, handle and drape which was in favour of the blend fabric.

INTRODUCTION

A certain amount of controversy regarding the attributes of blending South African Merino wool with imported merino wool had developed over the last few years. Some manufacturers prefer 100% Cape wools whereas others prefer imported/Cape blends. The criterion appears to be the aesthetic quality of the fabric, in particular its handle and wrinkling propensity.

It was decided that a study should be carried out in order that the controversy be resolved, by investigating the processing performance, yarn properties and fabric properties of a Cape wool, an imported wool and a 50/50 blend of these two.

EXPERIMENTAL

Grease wool

A bale of typical good topmaking merino wool of 64's quality was *imported,* and a bale of Cape merino wool of 64's quality was then selected to match the imported bale as closely as possible in respect of mean fibre diameter, staple length and crimp frequency.

Each bale was core tested for yield and mean fibre diameter and then opened up, divided in small pieces by hand and thoroughly mixed. Three lots each having the same clean mass were formed comprising 100% imported wool, 50/50 imported/Cape blend and 100% Cape wool.

Scouring

The three lots were scoured separately in a Petrie and McNaught pilot scale scouring plant equipped with a suction drum dryer. The temperature of the liquors in the four bowls were 55°, 55°, 50°, and 40°C respectively.

The first bowl was charged with 0,02% (v/v) of ®Berol Lanco and 0,1% (m/v) of soda ash. Supplementary additions of soda ash were made after every 15 minutes at a rate approximately equal to 1,5 kg soda ash/100 kg greasy wool. Detergent additions were also made at 15 minute intervals in an attempt to maintain an average residual grease content of about 0,6%. The amounts of detergent added to bowls 1, 2 and 3 were deliberately apportioned in the ratio 1 : 1,2 : 0,4 in order that the grease and other impurities were progressively removed without any obvious overscouring or underscouring at any stage. The fourth bowl was used as a rinse bowl. The production of grease wool was set at 60 kg per hour. The scoured wool was dried at 70°C, sprayed with a lubricating emulsion, (0,35% ®Topsol X-LAS, 0,05% ®Lissapol NX and water), layer blended and allowed to condition for five days.

Carding and Combing

Each lot was carded, gilled three times, combed and finished in the same manner and with the same intervals between processes. Carding was carried out on an F.O.R. double swift Continental worsted card clothed with metallic wire. The swift speed was set at 78 rev/min and the production rate at 16 kg/hr. Preparatory gillings were carried out on a Schlumberger intersecting gill box type GNP using a pin density of 6,5 pins/cm. During the first and second gillings, water was sprayed onto the slivers as they were fed into the machine in order to increase the regain to about 20% prior to combing. The nominal drafts used at the first, second and third gilling were 6,7 and 8 respectively and the ratch was set at 37 mm in each case.

Combing was carried out on a Schlumberger PB 26 comb at a gauge of 30 mm and using a top comb of pin density of 28 pins/cm. The combed slivers were finished by passing through an NSC autoleveller gill box twice and were then wound onto suitable tubes for top dyeing.

Dyeing

The three lots of wool tops were prescoured with 0,5 g/ℓ ®Ultravon HD and subsequently dyed by the afterchrome process to a 3,4% depth of shade with 2,0% ®Eriochrome Blue SBP plus 1,4% Eriochrome Blue SE 140.

Backwashing and Re-combing

The dyed tops were backwashed in a two-bowl Fleissner unit equipped

with a suction drum dryer. The first bowl was charged with 0,02% ®Lissapol NX (v/v) in hot water at 50° C. The second bowl was used as a rinse bowl only. Drying took place at 60° C.

After backwashing the wools were gilled three times on a Schlumberger gillbox type GNP. During the first gilling the slivers were sprayed with 0,6% (o.m.f.) ®Bevaloid 4027. The wool was then recombed on the same comb used for first combing. The gauge was set at 30 mm as before, but a top comb of finer pin density was used, namely 30 pins/cm. The comb loading was 290 ktex. The re-combed slivers were finished by two passages through an NSC autoleveller gillbox.

Drawing and Spinning

There were four drawing operations from top to roving. During the first drawing operation the linear density of the tops was reduced on an NSC intersecting gill box type GNP. The second and third operations were carried out on an NSC intersecting gillbox type GN 4 and the final operation on an NSC double apron high draft draw frame, type FM1. The linear density of the tops was reduced progressively from 20 ktex to 12 ktex, 6 ktex, 3 ktex and 450 tex respectively during these operations.

Spinning was carried out on a Rieter H6 worsted ringframe. Each lot was spun on 48 spindles using 60 mm rings to 25 tex Z 575 and plied to give R50 tex S 575/2 Z 575 yarn. The singles yarns were not steamed. Anti snarling devices were used to prevent snarling during the unwinding from the spinners packages.

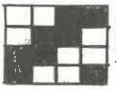
Clearing and Preparation

Each lot of plied yarn was steamed before clearing on a Schlafhorst winder fitted with an Uster Classimat recorder and electronic clearers.

Warping and Weaving

The fabric specification was as follows:-

Design:



weave	: 2/2 twill (fancy)
reed	: 15,5/4 dents/inch or 6,07 dents/cm
width in reed	: 170 cm
warp	: R50 tex/2 ground (navy) 100% wool
	R28 tex/2 stripe (grey) 55/45 polyester/viscose
	R64 tex/2 stripe (light blue) 100% mohair

weft : R50 tex/2 100% wool
ends per cm : 28,7 (finished)
picks per cm : 25,2 (finished)
fabric mass (g/m^2) : 290 (approximately)
Warp pattern repeat :

ground (blue)	44		5		44		93
stripe (grey) (extra)		2		2			4
stripe (light blue)						1	1
					TOTAL:		98

The warps were prepared on a Gordon Warin sample section warping machine and woven in a 190 cm Saurer 100 WT 4-box pick and pick loom fitted with dobby running at 140 picks/minute.

The fabrics were perched, burled and mended and finished commercially.

Finishing

The three fabrics were joined end to end and finished in an identical manner, the procedure was blowing, scouring in rope form on an Henner SLD 180 jet scouring machine using non-ionic detergents, crabbing at 65°C for 15 minutes, tenter drying, conditioning, steaming, cropping and rotary pressing before finally KD decatising.

Physical testing

The yarns and fabrics were tested for physical properties and where possible standard testing procedures were employed as described by Smuts and Hunter[1].

The fabrics were examined by 10 judges and ranked in handle from the softest to the harshest. The consistency of the ranking of the judges was assessed in terms of the coefficient of concordance.

RESULTS AND DISCUSSION

Greasy wool

Characteristics of the greasy wool are given in Table I. The greasy wools appeared to be well matched excepting for the CV of crimp. The latter results

show that there was considerably more variation in the staple crimp of the imported wool.

Scouring

The scouring details and results are shown in Table II. It is clear from these results that considerably more detergent was required to scour the Cape wool than the imported wool but the blend required an intermediate amount.

TABLE I

CHARACTERISTICS OF THE GREASY WOOL

CHARACTERISTIC	Type of wool	
	Imported	Cape
Mean fibre diameter (μm)	21,4	21,2
CV (%)	23,4	22,0
Staple length (unstretched, cm)	7,6	7,6
CV (%)	11,9	14,1
Mean fibre length (mm)	86,3	86,4
CV (%)	31,0	26,9
Crimp frequency (number of crimps/cm)	4,4	4,1
CV (%)	30,7	17,4
Resistance to compression (mm compressed height) after hand scouring and steaming)	21,8	21,6
Bundle tenacity (cN/tex)	9,5	9,4
Bundle extension (%)	23,0	23,2
Staple length (stretched, cm)	8,2	8,1
CV (%)	11,8	13,8
IWTO clean yield (%)	69,1	66,7
Vegetable matter base (%)	1,67	0,61

Residual grease results were not easy to control because of the small quantities which were scoured and although the Cape Wool and the 50/50 imported/Cape blend had similar residual grease levels, the results for the imported wool were slightly lower. Regains were similar for all these blends. Yields were all lower than suggested by the core test, probably due to the small quantities involved. The yield of the 50/50 imported/Cape blend was between the other two.

TABLE II

DETAILS OF SCOURING AND RESULTS

DETAILS	Imported	50/50 Blend	Cape
Supplementary additions of detergent (mℓ):			
To bowl 1	300	650	1 000
2	360	780	1 200
3	120	260	400
Residual grease content of scoured wool (%)	0,45	0,65	0,71
Regain after scouring (%)	11,8	11,8	11,4
Scoured yield (%)	68,1	65,9	64,1

Carding and Combing

The results for carding and combing are given in Table III. The burrs rejected by the card were slightly higher for the imported wool than the Cape as would have been expected from the core test results for vegetable matter base. Neps and vegetable matter particles in the carded slivers were also slightly higher for the imported than the Cape wool, with the results for the 50/50 blend being intermediate as expected.

The gilling results for neps, vegetable particles and dichloromethane extractable matter confirmed the above trends, but differences were slight. The combing results, on the other hand, showed up significant differences in the behaviour of the different lots, the imported wool giving the poorest performance and the Cape wool the best. Not only was the percentage noil for the imported wool about 50% higher than for the Cape wool, but the mean fibre length of the top was nearly 7 mm shorter and the CV of mean fibre length nearly 10% greater. The tops were all of approximately the same diameter, cleanliness and compressibility.

TABLE III

CARDING AND COMBING RESULTS

	Imported	50/50 Blend	Cape
Carding			
Regain prior to carding (%)	14,3	14,3	13,9
Card burrs (% on greasy)	1,0	0,8	0,4
Card fettlings (% on greasy)	1,2	1,2	1,2
Card fittings (% on greasy)	0,8	0,8	1,4
Production rate (kg/hr)	16,2	16,1	16,0
Dichloromethane extractable matter	0,9	1,1	1,4
Neps per 20 g in carded sliver	211	182	153
Vegetable particles per 20 g in carded sliver	543	449	300
Withdrawal force of carded sliver (N/g)	230	190	193
Gilling			
Average linear density [3 gilling (ktex)]	22,2	21,6	22,2
Dichloromethane extractable matter after 3 gillings (%)	0,84	1,07	1,09
Neps per 20 g after 3 gillings	247	176	165
Vegetable particles per 20 g after 3 gillings	536	452	216
Withdrawal force after 3 gillings (N/g)	77	102	68
Regain after 3 gillings (%)	21	19	20
Combing			
Production rate (kg/hr)	8,2	8,4	8,6
Tear (ratio top: noil)	14,3:1	18,1:1	23,5:1
Noil (%)	6,5	5,2	4,3
Regain of top (%)	17	17	17
Comb shoddy (% on greasy)	0,3	0,3	0,3
Mean fibre length of top (mm)	61,6	64,9	68,4
CV (%)	50,6	45,5	40,7
Fibres shorter than 25 mm (%)	7	6	5
Dichloromethane extractable matter (%)	0,78	1,05	1,08
Mean fibre diameter of top (μm) (airflow method)	21,2	21,4	21,4
Neps per 20 g in top	23	17	21
Vegetable particles per 20 g in top	14	16	10
Withdrawal force of top (N/g)	59	53	49
Resistant compression after steaming (compressed height, mm)	19,4	19,7	18,9
Bundle tenacity (cN/tex)	10,1	9,7	9,4
CV %	3,0	2,3	6,0
Bundle extension (%)	18,3	18,6	17,6
CV %	8,9	10,2	11,8

Re-combing

Results for some physical tests carried out after top dyeing, backwashing and re-combing are shown in Table IV.

TABLE IV

RESULTS OF PHYSICAL TESTS AFTER RE-COMBING

	Imported	50/50 Blend	Cape
Tear	78:1	98:1	109:1
Noil (%)	1,26	1,01	0,91
Mean fibre length of top (mm)	65,0	67,6	71,3
CV (%)	49,6	45,6	40,1
Fibres shorter than 25 mm (%)	6	6	6
5 per cent length (mm)	109	109	108
Tail length: mean length ratio	1,68	1,61	1,51
Dichloromethane extractable matter (%)	0,6	0,6	0,6
Resistance to compression after steaming (mm Compressed height)	15,6	15,7	15,8
Neps per 20 g in recombed top	9	10	10
Vegetable particles per 20 g in recombed top	2	1	1

The results again show that the Cape wool gave the better performance. The mean fibre lengths of the tops were all about 3 mm greater than after the first combing. In view of the very small amount of noil removed and approximately the same short fibre content, it would appear that some crimp removal had occurred with a corresponding increase taking place in the Almeter reading. This is supported by the resistance to compression results.

Spinning

Spinning results are given in Table V. The results show that there was hardly any difference between any of the blends from the point of view of spinning potential. The fact that the imported lot was considerably shorter than the Cape lot did not appear to have a significant effect on the mean spindle speed at break, or the commercial spindle speed.

TABLE V

SPINNING RESULTS

	Imported	50/50 Blend	Cape
Mean spindle speed at break revs/min	12 750	12 906	12 427
Commercial Spindle Speed	9 000	9 250	8 550
End breaks (per 100 spindle hours)*	1	0	0

* 48 spindles/4 hrs at 8 500 revs/min

Yarn Properties

The results of physical tests on the yarns in both singles and plied form are shown in Table VI. The breaking strengths results indicate that the blend yarn was slightly stronger than the other two yarns. The blend yarn was also the most extensible and had the lowest CV for both these tensile properties. The blend yarn was also slightly more regular and had the lowest number of thick and thin places. Although the differences were very small together they gave the impression that the blend yarn was superior to either of the yarns from the imported or Cape wools individually.

TABLE VI

YARN PROPERTIES OF IMPORTED, 50/50 BLEND AND CAPE WOOLS

Yarn Lot	Yarn Linear Density (Tex)			Breaking Strength (cN)	CV (%)	Extension (%)	CV (%)	Irregularity CV (%)	Thin Places per 1 000 m	Thick Places per 1 000 m	Neps per 1 000 m
	Nominal	Mean	CV (%)								
Imported	R50	50,0	1,54	390	9,2	29,8	18,0	13,7	—	—	—
	25	24,7	0,33	164	12,9	15,5	33,0	18,2	99	42	4
50/50 blend	R50	51,0	1,65	396	7,7	30,9	14,8	13,0	—	—	—
	25	25,3	2,31	159	15,0	13,9	33,4	17,9	88	33	4
Cape	R50	49,8	1,47	384	8,0	28,5	22,9	13,7	—	—	—
	25	24,6	0,84	161	13,3	13,5	39,1	18,5	115	52	5

TABLE VII

DIMENSIONAL CHANGES OF FABRIC DURING FINISHING

STATE	Imported	50/50 Blend	Cape
Unfinished width (cm)	160	161	161
Scoured width (cm)	154	154	154
Dried width (cm)	155	155,5	155,5
Width after stentering (cm)	156	157	156
Width at final perch (cm)	152	152	151
Unfinished length (m)	24,9	26,05	28,05
Finished length (m)	24,1	25,2	25,2
Mass (g/m^2)	287	284	279

Fabric properties

Table VII gives the dimensional changes in the fabric during finishing.

It can be seen that in the unfinished state there was 1 cm difference in fabric width between the imported and the Cape fabrics, the imported fabric apparently contracting a little more in the loom. However, the final width at the perch showed that the Cape and the imported fabrics were the same (152 cm) and the blend finished 1 cm narrower. These differences are very slight. The fabric mass results showed that the blend fabric had the lowest mass 284 g/m^2.

The percentage loss in length from unfinished to finish state was 3,2, 3,3 and 3,3% respectively and does not give an indication why the blend fabric should be slightly lighter fabric.

From Table VIII it can be seen that the three fabrics were of similar mass and thickness. The sett of the fabric woven from 100% imported merino wool was slightly higher in the warp than either the 50/50 blend or the Cape fabric. This is in agreement with the mass of the fabrics. Air permeability, crimp, Martindale abrasion and tensile properties were virtually identical. Any difference were small and of no practical consequence. The deformability of the *blend* fabric, however, was significantly higher than the other to fabrics and the drape was much lower. The drape coefficient indicated that the fabric was softer and this was confirmed by the bending lengths and flexural rigidity. A subjective handle examination also confirmed this fabric as being the softest.

TABLE VIII

PHYSICAL PROPERTIES OF A 2/2 TWILL SERGE FABRIC WOVEN FROM IMPORTED, 50/50 BLEND AND CAPE WOOLS

FABRIC PROPERTIES		100% Imported	50/50 Blend	100% Cape
Fabric mass per unit area (g/m^2)		287	284	279
Fabric Thickness (mm)		0,60	0,57	0,58
Fabric Sett				
ends per cm		31	29	29
picks per cm		24	24	24
Air Permeability ($m\ell/s/cm^2$)				
measured at 2,5 kPa water pressure		7,0	7,5	7,4
Weave Crimp (%)	Warp	8,8	7,9	8,8
	Weft	11,8	11,1	12,1
Martindale Abrasion				
(% mass loss at 1 000 cycles)		2,4	2,3	2,4
Martindale Pilling				
(IWS method 1 is poor; 5 is good)		5	5	5
Bursting Strength (kN/m^2)		1200	1190	1183
Fabric Tensile Properties				
Strength (N)	Warp	571	581	567
	Weft	419	415	443
Extension at Break (%):				
	Warp	45,6	47,4	47,5
	Weft	47,4	41,8	48,1
Deformability (%)				
Immediate	W	0,70	1,16	0,85
	F	1,33	1,43	1,43
	W + F	2,03	2,59	2,28
Delayed	W	1,26	1,86	1,43
	W	2,35	2,35	2,35
	W + F	3,61	4,21	3,78
Drape Coefficient (%)		66,3	59,7	66,5
AKU Wrinkling [S.D. of wrinkle recovery curve (mm)]				
Aged	Warp	0,19	0,10	0,24
	Weft	0,13	0,17	0,18
De-aged*	Warp	0,30	0,20	0,25
	Weft	0,20	0,15	0,21
AKU Wrinkling				
AATCC Rating (1 is poor 5 is good)				
Aged	Warp	3,2	3,8	2,7
	Weft	4,2	3,0	3,5
De-aged*	Warp	4,2	3,0	3,5
	Weft	3,3	3,3	2,8
Monsanto Crease Recovery Angle (degrees)				
	Warp	140	143	146
	Weft	143	146	148
	W + F	283	289	294
Bending Length (cm)				
	Warp	2,04	1,92	2,04
	Weft	1,82	1,74	1,80
	Mean	1,93	1,83	1,91
Flexural Rigidity (mN/mm)				
	Warp	23,9	19,7	23,2
	Weft	17,0	14,7	15,9
	Mean	20,5	17,2	19,6
Area Relaxation Shrinkage (%)		3,2	3,3	4,3
Area Felting Shrinkage (%)		20,6	20,7	18,0
DP Rating (1 is poor; 5 is good)		1,3	1,2	1,0
Subjective handle		Soft	Softest	Soft

* To cancel any ageing effects the fabrics were soaked in water at 20° C for 30 min., centrifuged, steam pressed while still damp before being conditioned at 27° C and 75% RH for 24 hours before being creased, and recovered for 1 hour 20° C and 65% RH.

The Cape wool fabric was marginally lighter in mass and had a lower consolidation during finishing and this reflected in the washing tests when this fabric had a slightly higher relaxation shrinkage than either the blend or the 100% imported fabric. The DP ratings of all the fabrics were poor which was not unexpected since the wool had not been shrink-resist treated. The AKU wrinkling indicated that the blend fabric had the best wrinkle recovery but the imported fabric generally had the best appearance after wrinkling when compared with AATCC standard photographs.

Generally there was little to choose between the performance of these three fabrics and it was concluded that the 50/50 blend produced a fabric with the softest handle, slightly better wrinkle resistance and the lowest drape.

SUMMARY AND CONCLUSIONS

A comparison of performance and properties at various processing stages was made between an imported 64's and a Cape 64's fleece wool of good topmaking style. A 50/50 blend of the two wools was also included in the trials.

The two greasy wools which were selected were closely matched in most of a comprehensive range of physical properties which were tested, excepting for the CV of staple crimp which was noticeably higher for the imported wool.

There were differences in processing performance between the imported wool and the Cape wool and the performance of the blend was roughly midway between the two.

Differences during carding and preparatory gilling seemed, to all intents and purposes slight. During combing and re-combing, however, significant differences between the performance of the different lots were evident, the imported wool giving the poorest performance and the Cape wool the best. The mean fibre length of the imported wool top was more than 6 mm shorter than that of the Cape top. This did not, however, appear to have a deleterious effect on the spinning potential of the imported wool, no significant differences being detected between any of the three blends when spun to 25 tex.

No significant differences were found between the three yarns. When woven into a 2/2 twill stripe suiting fabric, again no differences were observed between the performance of the yarns either during preparatory processes or during weaving. Weaving performance was excellent.

The three yarns produced fabrics having virtually identical properties excepting for handle and drape. The 50/50 blend had the softest handle and the lowest drape coefficient and marginally better wrinkle resistance.

THE USE OF PROPRIETARY NAMES

®Berol Lanco, ®Topsol and ®Lissapol are the registered proprietary names of Messrs. Berol Aktiebolag, Price Ltd. and ICI respectively.

®Ultravon and ®Eriochrome are the registered proprietary names of Messrs. Ciba Geigy. ®Bevaloid 4027 is the registered proprietary name of Messrs. Bevaloid S.A. Limited.

The fact that chemicals with proprietary names have been mentioned in this report in no way implies that SAWTRI recommends them or that there are not others which are as good or better.

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Permission of the S.A. Wool Board to publish the results is gratefully acknowledged.

APPENDIX

SAMPLE OF FABRIC WOVEN FROM A 50/50 BLEND OF IMPORTED AND CAPE MERINO WOOL

REFERENCE

1. Smuts, S. and Hunter, L. Studies of Some Wool/Acrylic Woven Fabrics, Part I: Unstretched plain and 2/2 twill weave fabrics from wool blended with regular acrylic *S.A. Wool and Textile Res. Inst. Tech. Rep.* No. 305 (June 1976).

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