SAWTRI TECHNICAL REPORT

No. 227

The Processing of Wool/Cotton Blends on the Worsted System

Part I–An Introductory Investigation

by

D. W. F. Turpie

SOUTH AFRICAN WOOL AND TEXTILE RESEARCH INSTITUTE OF THE CSIR

P. O. BOX 1124
PORT ELIZABETH
REPUBLIC OF SOUTH AFRICA

ISBN 0 7988 0415 7

THE PROCESSING OF WOOL/COTTON BLENDS ON THE WORSTED SYSTEM

PART I : AN INTRODUCTORY INVESTIGATION

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ABSTRACT

Hand-blended lots of scoured 6/7 months Spinner's wool and mechanically-opened Acala 442 cotton lint were successfully carded, gilled and combed on the worsted system. Blend ratios selected were 70/30 and 50/50 wool/cotton. In the latter case the production rate was about 50 to 60 per cent of that for wool alone. Significant improvements in performance were possible by applying a lubricating oil to the blend prior to carding. A level of application of about 0,5 per cent resulted in most satisfactory all-round performance. Of particular interest was the observation that the improvement in the performance of the cotton component due to lubrication was more pronounced than that of the wool. It is suggested that higher production rates may be possible by selecting cottons of lower nepping potential.

Drawing and spinning of re-combed tops composed of 55/45 wool/cotton and originating from this investigation, were successfully carried out on conventional worsted equipment. The yarn, 21 tex Z860, had a good appearance but was a little irregular.

KEY WORDS

Wool/cotton blends — worsted system — neps — percentage noil — mean fibre length — lubrication.

INTRODUCTION

The various stages of manufacture through which a textile fibre passes in its conversion from raw material to yarn have, for reasons of optimum processing efficiency, but in many cases also for reasons of necessity, been tailored to suit the particular fibre. In the case of some fibres the particular manufacturing system has even been tailored to suit various grades or classes of fibre and also the end use. Thus we find, for example, that cotton is processed on the "Cotton System" and wool is processed on the "Woollen System" or the "Worsted System".

While the woollen system has been developed to cater for a wide range of fibre lengths, it is admirably suited to the processing of very short wools and waste materials. The worsted system on the other hand has been developed to cater for wools which generally have lengths in excess of 40 mm but may be up to some 300 mm in extreme cases. The worsted system can be further sub-divided into the "Bradford System" and the "Continental System". The characteristics of the yarns produced on the woollen and worsted systems can differ considerably, the former often being rough and "Whiskery" and having a bulky handle, the latter being generally smooth and with a less bulky handle. The character of the worsted yarns is largely attributed to the fact that the fibres are straightened and combed during the manufacturing process.

Variation in the lengths of available cottons grown in various parts of the world is relatively much smaller than that found for wool, being in the range of approximately 15 mm to 45 mm. The bulk of the World's cotton has a staple length of approximately 25 mm to 30 mm and is therefore only comparable in length with the shortest of virgin wools e.g. the merino wools of about 6 months length which are available in South Africa. Most cottons are spun into yarn without prior combing. A few, generally the longest or highest grade cottons, are combed. This is particularly necessary, for example, for the manufacture of high grade cloth (e.g. shirting) and for blending at the drawframe with, for example, polyester staple.

Although each of these fibres, wool and cotton, is normally processed on a system and in a manner to suit itself, there is good reason to consider the processing of a blend of both of them for certain end uses. Wool/cotton blends are well-known, for example, in certain fields of underwear and in certain shirting fabrics where it is particularly desirable to combine the physical properties relating to durability and comfort.

For adequate fibre control during the necessary process of drafting associated with yarn manufacture, however, it is obvious that the two components of the blend should be as closely matched in fibre length distribution as possible. Wool noils, for example, have been used in blends with cotton for the production of blankets. Cape lambs wool has been used in blends with cotton for the production of higher quality fabrics. Such blends often contained less than 20% of wool and were processed on the cotton system after suitable machine modifications.

The processing of wool fibres on the cotton system was very wasteful in the early stages, the waste produced increasing with increasing wool content of the blend, and often reaching more than 20%. Recent developments have included the modification of the conventional cotton card and the drafting system of conventional cotton ring spinning frames enabling longer wools to be processed with reduced waste losses. This modified system is known as the mid-fibre system. This system has not gained popularity excepting in the processing of man-made fibres. Due to the high cost of waste losses caused by processes prior to the drawframe the popular method of producing wool/cotton blends on the cotton system now appears to involve the use of wool tops or specially prepared worsted slivers at the drawframe stage [1, 2]. This type of blending, however, cannot be regarded as being as intimate as when a carding machine is used.

The advantages of the worsted system of wool yarn production are numerous but are particularly centred around the sleekness and general superiority of the yarns. Although the production of blends of wool and other fibres on this system therefore has an obvious appeal, it is clear from the foregoing that a moderately long cotton would probably have to be selected to achieve adequate fibre control on the blend during mechanical processing. It is by no means clear, however, that the worsted system can succeed since such processes as carding and combing, for example, may prove to be impractical or inefficient. Large and therefore uneconomical, amounts of noil, for example, may be produced during combing. Also, the worsted card may not be equipped to deal with the unravelling of cotton neps. Production rates may have to be changed. It seemed of interest, therefore, to make a preliminary study of the possible processing of wool/cotton blends on the worsted system.

EXPERIMENTAL

Two series of investigations were carried out on hand-blended lots of wool and cotton under conditions of relative humidity and temperature of 70 *per cent* and 21° C, respectively. The components were layer-blended and the blend then thoroughly mixed by hand in each case.

Raw Materials:

The cotton used was of the cultivar known as Acala 442 – a good grade hand-picked cotton. The cotton lint was found to have a micronaire value of 3, 7, a 2,5% span length of 29,6 mm (staple length approximately 29 – 30 mm), a 50% span length of 14,2 mm and a mean length of 25,8 mm. Sufficient cotton lint for the two series of investigations was taken from this lot and processed through a standard blowroom line. The latter consisted of a porcupine opener followed by a two-bladed beater each having its own hopper/blender unit attached. The cotton was removed by hand from the line prior to entering the final lap forming stage to have it in as open a state as possible. The wool which was used was obtained from a two-bale lot of 6/7 months Spinner's Style 64's. Each bale had been scoured separately on different occasions to residual grease levels of 0,24 and 0,23 *per cent* respectively. The products could therefore not be described as identical although they were closely similar. The product from one bale was used for the first series of experiments whereas the product from the other bale was used for all the experiments in the second series.

that the blends before carding were fairly near to a state of equilibrium with the room conditions and were perhaps, if anything, slightly dry.

Gilling:

In all experiments the blends were gilled three times on an NSC intersecting gill box type GNP on the day following carding using successive drafts of 4,1 4,4 and 4,6. The ratch was set at 25 mm. The number of doublings in each experiment was varied where necessary to try and obtain linear densities of the slivers of around 9, 12 and 15 ktex after the first, second and third gillings. In the case of all gillings fallers of pin density 6,5 p.p. cm were used at a speed of approximately 900 drops per minute (this was about 75 *per cent* of the full speed recommended for this particular model). Neither water nor lubricant was applied to the slivers during gilling.

Combing:

Combing was carried out on a Schlumberger PB26 comb at a gauge setting of 22,5 mm and a nominal feed of 4,75 mm. A top comb of pin density 30 p.p. cm and a segment of the Nitto Unicomb type suitable for use with 64's wool were used. The comb loading was about 180 ktex which was equivalent to about 65 *per cent* of the full loading recommended for fine merino wool for this particular model. The number of nips per minute was set at 150 whereas this might have been 165 had the wool been combed alone. Four tests were made to determine the percentage noil in each case and the results corrected for regain. For this purpose an arbitrary standard regain for both the tops and noils of 12,0% was selected. This was conveniently between the standard regains for scoured wool and cotton of 16% and 8½% respectively. In actual fact the regains of the combed slivers and the noils as they emerged from the comb during the experiments were about 10 – 12 *per cent* and 7 – 9 *per cent* respectively. After combing the slivers were passed through an NSC autoleveller gill box twice.

Spinning of 55/45 Wool/Cotton Blend:

Subsequent to the first and second series of investigations described, all the tops which had been produced from the 50/50 blend, together with additional tops produced from identical surplus material, were re-combed. The re-combed tops were finished by two operations of gilling through an autoleveller gill box set at a draft of 5 and a ratch of 25 mm. The composition of the blend was established by chemical analysis and found to be 54,6% wool, 45,4% cotton. The number of neps in the re-combed tops was found to be 196 per 20 g, but over 90 *per cent* of these were estimated to be extremely small (less than 0,5 mm in diameter).

There were four operations of drawing each of which was carried out at about 75 *per cent* of the commercial speeds which would have been selected for the wool component. At the first operation the linear density of the slivers was reduced to 14,8 ktex using a Schlumberger intersecting gill box type GNP set at a ratch of 25 mm and a draft of 4,5 and using fallers of pin density 6,5 p.p.cm. The second and third operations of drawing were carried out using an intersecting gill box type GN 4 with the ratch set at 23,5 mm and using fallers of pin density 9 p.p.cm. Successive drafts were 5,2 and 5,7 so that the linear density of the slivers was reduced to 5,7 and 3,0 ktex respectively. To prevent the slivers from breaking during their passage through the gill box the tensions between the creel and the back rollers, and between the front rollers and the coiler on the GN 4 had to be slackened. In addition the funnel guides between the front rollers and the coiler head had to be removed due to the bulkiness of the slivers. The fourth operation of drawing was carried out on a Schlumberger double apron high draft rover, type FM 1, set at a draft of approximately 13. For improved control in the drafting zone the discs between the aprons were removed, and two weights were used instead of one for applying pressure to the front apron tumblers. Tensions were reduced on the creel and also between the front rollers and the rubbing aprons and between the rubbing aprons and the balling head. The back draft was also reduced. The rubbing frequency was set at maximum, namely 360 cycles/minute at a delivery speed of 30 m/minute. The rubbing traverse was also set at maximum, namely 30 mm. Smaller plastic condensers than normally used were fitted between the aprons and the front rollers. Delivery was made onto plastic barrels, 240 mm long and 75 mm in diameter. The advantage of the use of these barrels was that their mass (155 g) was much smaller than that of the conventional wooden bobbin and that therefore unwinding would be easier on the creel of the spinning frame. The draft used at the roving operation was 13,3 so that the linear density of the roving produced was 450 tex.

Spinning was carried out on a 144-spindle Rieter worsted spinning frame Model H6. This was of the collapsed balloon type. Rings were 60 mm in diameter, the draft used was 21,4. A yarn of 21 tex Z860 was produced. Spinning was carried out at a commercial spindle speed of 7 500 r/min. Over 80 kg of yarn was spun. The yarns were autoclave steamed at 100 °C for 10 minutes under a vacuum of 660 mm Hg and then conditioned and subjected to various physical tests.

Testing:

Regain was determined by drying to the bone dry state. Neps and vegetable particles were counted visually on a Toenniessen top testing machine using transmitted light. A minimum number of 1 200 total faults were counted in every case and the results expressed per 20 g mass of sliver. Mean fibre lengths after combing were measured on an Almeter. Although the presence of cotton may have tended to introduce inaccuracies in the latter results due to differences in fibre fineness and dielectric constants the results are presented as a probable basis for comparison. Percentages of wool and cotton in the tops and noils were determined by chemical analysis according to the methods prescribed by the IWTO.

Yarn breaking strength and extension were determined using an Instron tensile tester. Yarn irregularity was determined using an Uster Evenness Tester.

RESULTS AND DISCUSSION

FIRST SERIES

Carding Performance:

The cleanliness of the carded slivers which were produced from 70/30 blends of wool and cotton for various card production rates and conditions of lubrication is given in Table I. It is clear from table I that the number of neps in the carded slivers increased with the card production rate. Although the increase was small when the production rate was increased from 8,4 to 10,0 kg/hr, it was extremely large when the production rate was further increased to 12 kg/hr. The nep count was so high at the latter rate that this rate was regarded as impractical from a commercial point of view. When comparing the results of the control test with those of the lots which were lubricated it seemed that the overall tendency may have been marginally in favour of lubrication. When comparing the results of the lots to which different lubricants had been applied and in different manners, variability in the results precluded the drawing of any specific conclusions. It appeared, however, that it was of little importance, from the point of view of the nep count, which of the two lubricants was selected, and whether the lubricant was applied to the wool only, or to the mixture. The number of vegetable particles in the carded slivers was relatively low and of a similar order in all experiments.

TABLE I

THE CLEANLINESS OF CARDED SLIVERS AND COMBED TOPS PRODUCED FROM 70/30 BLENDS OF WOOL AND COTTON FOR VARIOUS CARD PRODUCTION RATES AND CONDITIONS OF LUBRICATION

	CARD PRODUCTION RATE (kg/hr)					
	8,4		**10,0**		**12,0**	
	Neps	**Veg**	**Neps**	**Veg**	**Neps**	**Veg**
Neps and vegetable particles per 20g in carded slivers						
Control test (No lubricant)	549	254	616	229	2378	234
Topsol applied to wool only	317	256	606	258	2903	274
Topsol applied to mixture	331	265	679	257	2184	262
Oxitex 40 applied to wool only	385	255	544	228	2162	201
Oxitex 40 applied to mixture	365	229	575	233	2458	153
Average for lubricated lots	350	251	601	244	2427	223
Neps and vegetable particles per 20g in combed tops	**Neps**	**Veg**	**Neps**	**Veg**	**Neps**	**Veg**
Control test (No lubricant)	108	20	103	10	223	5
Topsol applied to wool only	88	20	102	20	212	14
Topsol applied to mixture	73	11	114	12	169	21
Oxitex 40 applied to wool only	95	16	105	16	203	10
Oxitex 40 applied to mixture	93	8	88	18	193	12
Average for lubricated lots	87	14	102	17	194	14

The cleanliness of the combed tops which were produced from the 70/30 blends of wool and cotton is also given in Table I. Similar conclusions could be drawn from these results as in the above case, namely that the nep count may have been marginally lower in the case of the lots which had been lubricated before carding, but that the manner of application was of little importance. The number of neps in the tops could be considered as being slightly high, but not excessive, in the case of the lots which had been carded at 8.4 and 10,0 kg/hr. In the case of the lots which had been carded at

TABLE II

THE CLEANLINESS OF CARDED SLIVERS AND COMBED TOPS PRODUCED FROM 50/50 BLENDS OF WOOL AND COTTON FOR VARIOUS CARD PRODUCTION RATES AND CONDITIONS OF LUBRICATION

	CARD PRODUCTION RATE (kg/hr)					
	5,6		8,3		9,9	
	Neps	Veg	Neps	Veg	Neps	Veg
Neps and vegetable particles per 20g in carded slivers						
Control test (no lubricant)	394	288	562	236	1098	208
Topsol applied	408	260	527	271	944	231
Neps and vegetable particles per 20g in combed tops	Neps	Veg	Neps	Veg	Neps	Veg
Control test (no lubricant)	63	19	99	23	239	28
Topsol applied	61	21	98	16	139	26

12 kg/hr the very high nep count of the carded slivers was obviously responsible for the high nep counts of the resultant tops. The latter nep counts were considered too high for commercial purposes. The number of vegetable particles in the combed tops was satisfactory in all experiments, being composed almost entirely of little bits shorter than 3 mm.

The cleanliness of the carded slivers and tops which were produced from the 50/50 blends of wool and cotton for various card production rates and conditions of lubrication is given in Table II. In view of the higher percentage of cotton in the blend than in the previous case, a lower range of card production rates was selected, with the highest rate being 9,9 kg/hr. As in the previous case, the number of neps increased with card production rate. Again the increase was relatively small from the lowest to the middle rate selected, but was large from the middle to the highest production rate. Comparing the results of the control test with those of the lots which were lubricated, it is clear that as far as the nep count was concerned this particular application of lubricant offered no significant advantage. The number of neps in the tops from the lots which were carded at the lowest production rate was satisfactory. In the case of the lots which were carded at 9,9 kg/hr the number of neps in the tops appeared to be too high for commercial purposes. The number of vegetable particles in the carded slivers was relatively low and of a similar order in all experiments. The number of vegetable particles in the combed tops was satisfactory in all experiments, being composed almost entirely of little bits shorter than 3 mm.

The effect of the card production rate on the number of neps in the carded slivers is more clearly illustrated in Fig. 1 where different blend ratios are considered. For the purpose of this illustration average results of control tests and lubricated lots taken from Tables I and II have been used for the 70/30 and 50/50 blends. Additional experiments were carried out on 100% cotton and on 100% wool (without the use of a lubricant) and the results of these experiments are also shown in the figure. It is clear that in the range of card production from 4,6 to 12,0 kg/hr the number of neps in the card slivers from 100% wool was negligible. The number of neps in the card slivers from 100% cotton, however, was considerable, increasing from about 1 000 per 20 g at a card production rate of 4,6 kg/hr to about 1 300 at 8,4 kg/hr. The results for the 50/50 and 70/30 blends lie approximately in the regions which would be expected according to the proportions of the two components. It is clear from the trend shown for the 70/30 blend that the number of neps eventually increases exponentially as a critical card production rate is approached. For this particular carding machine a commercial production rate for 100% wool (of a type similar to that used in the experiments described) would be expected to be about 16 kg/hr at a swift speed of 82 r/min. It is therefore quite obvious that considerably lower production rates would have to be tolerated in blends containing sizable proportions of cotton.

TABLE IV

COMBING PERFORMANCE OF 50/50 BLENDS OF WOOL AND COTTON CARDED AT VARIOUS PRODUCTION RATES WITH AND WITHOUT PRIOR APPLICATION OF A LUBRICANT

	CARD PRODUCTION RATE (kg/hr)		
	5,6	8,3	9,9
Percentage noil obtained			
Control test (no lubricant)	11,16	12,91	17,02
Topsol applied	9,72	11,07	14,99
Mean fibre length of top			
Control test (no lubricant) (mm)	35,4	35,0	32,3
% Fibre < 25 mm	22,9	22,7	31,8
Topsol applied (mm)	36,6	35,5	33,8
% Fibre < 25 mm	20,1	23,0	27,2

The mean fibre lengths of the tops produced from the control lots and from the lots which were lubricated, together with the percentage short fibre in the tops, are also given in Tables III and IV. (In Table III only average figures for all lubricated lots are given). These results should be read in conjunction with Figure 2 in which the relevant percentage noil results have been plotted against the various card production rates.

It can be seen from Tables III and IV that increases in the production rates during carding resulted in a significant reduction in the mean fibre lengths of the tops and in significant increases in the percentage of fibres shorter than 25 mm. The mean fibre length was reduced by up to 4 mm and the short fibre content increased by up to 9 *per cent*. It is also clear that the use of a lubricant significantly improved the mean fibre lengths of the tops by an average amount of approximately 1,4 mm. Slight changes in short fibre content were evident from the results given in Tables III and IV but on average it can be said that these were of little significance. It is obvious from these results and from the results shown in Figure 2 that lubrication of the fibres resulted in less fibre breakage during the conversion of the original blends into tops.

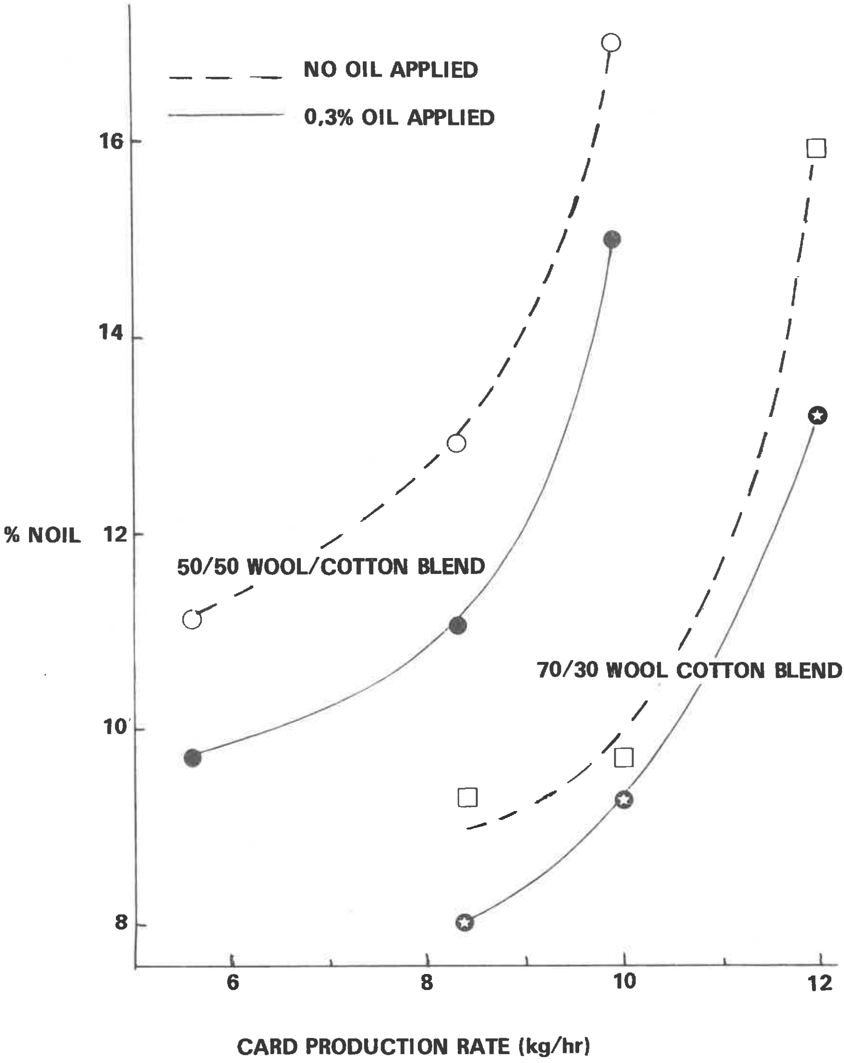

FIGURE 2

The effect of card production rate on the percentage noil obtained during combing for both 70/30 and 50/50 wool/cotton blends

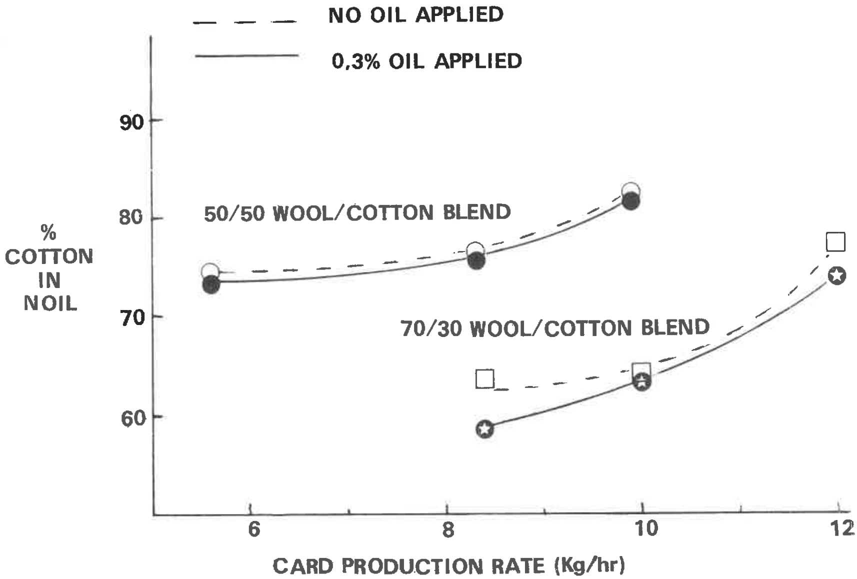

FIGURE 3

The effect of card production rate on the separation of cotton fibres into the noil during subsequent combing

The effect of the card production rate on the separation of the cotton and wool fibres during subsequent combing is indicated by the results of chemical analyses carried out on the noils which are presented in Figure 3. In the case of the blends which contained 30 *per cent* of cotton the noils were found to contain from about 60 to 75 *per cent* of cotton. In the case of the blends which contained 50 *per cent* of cotton the noils were found to contain from about 74 to 82 *per cent* of cotton. The relative proportions of cotton in the noils increased for higher card production rates. When a lubricant was used slightly less cotton went into the noil.

From the results shown in Figures 2 and 3 the combing performance of the *components* of the blends were calculated. These results are given in Table V. One aspect of these results appeared to be most interesting in that the amounts of noil produced from the wool component of the blend were constant for a given blend ratio and a given condition of lubrication within the limits of production under consideration. This indicated that the deterioration in the performances of the blends which were experienced with increased production was entirely due to increases in the amount of cotton neps and broken cotton fibres. Also of interest was the fact that the per-

TABLE V

COMBING PERFORMANCES OF THE INDIVIDUAL COMPONENTS OF 70/30 AND 50/50 WOOL/COTTON BLENDS CARDED AT VARIOUS PRODUCTION RATES WITH AND WITHOUT PRIOR APPLICATION OF A LUBRICANT

	PERCENTAGE NOIL	
	Comprising Cotton Fibres	Comprising Wool Fibres
70/30 BLEND		
Production rate (kg/hr)		
8,4 (No lubricant applied	5,76	3,54
(0,3% lubricant applied	4,68	3,34
Average	5,22	3,44
10,0 (No lubricant applied	6,00	3,67
(0,3% lubricant applied	5,73	3,53
Average	5,87	3,60
12,0 (No lubricant applied	12,30	3,65
(0,3% lubricant applied	9,78	3,43
Average	11,04	3,53
50/50 BLEND		
Production rate (kg/hr)		
5,6 (No lubricant applied	8,29	2,87
(0,3% lubricant applied	7,17	2,55
Average	7,73	2,71
8,3 (No lubricant applied	9,84	3,07
(0,3% lubricant applied	8,38	2,69
Average	9,11	2,88
9,9 (No lubricant applied	14,01	3,01
(0,3% lubricant applied	12,29	2,70
Average	13,15	2,82

centages of noil obtained from *both* the cotton *and* the wool components were lower when the fibres were lubricated. Under these particular conditions of lubrication the improvement in the combing performance of the cotton component due to the use of a lubricant exceeded that of the wool component.

Chemical analyses of the tops were carried out as a precautionary measure and the results obtained unfortunately did not corroborate many of the findings reported for the first series of investigations. The cotton contents of the tops were found to increase in all cases as the card production rate was increased. The blend ratios of the slivers which were combed were then calculated back from the results of these analyses. It appeared that in the case of the 70/30 blends the actual cotton contents of the blends which were combed were approximately 22, 26 and 38 *per cent* for the low, medium and high rates of card production respectively. In the case of the 50/50 blends the actual cotton content appeared to be 39, 43 and 54 *per cent* for the low, medium and high rates of card production respectively. Such results were extremely puzzling and the only explanation that can be offered, is that the card hopper feed selected proportionately more wool fibres at the beginning of the run than it did at the end of the run. In such an event it would mean that all trends discussed which were brought about by increases in the production rate tended to be over accentuated because of increases in the cotton content of the blends.

It is interesting to note that, in the case of the 70/30 blends, the actual cotton contents of the tops were approximately 19, 22 and 33 *per cent* for the low, medium and high rates of card production respectively. In the case of the 50/50 blends the cotton contents of the tops were approximately 35, 38 and 49 *per cent* for the low, medium and high rates of card production. Differences between these percentages and those pertaining to the blends before combing thus varied from about three to five *per cent*. This suggests that, at medium production rates, blends having compositions of 70/30 and 50/50 wool/cotton on entering the card would have produced combed tops having compositions of about 74/26 and 55/45 wool/cotton respectively.

SECOND SERIES

Carding Performance:

The number of neps in the carded slivers which were produced when various percentages of lubricant were applied to 50/50 wool/cotton blends before carding is shown in Figure 4. The results are given for three different combinations of worker and doffer speeds and the mean values, together with a visual best-fit curve, are also shown. Mean values are also shown for the number of neps in the combed tops which were produced from the respective card slivers.

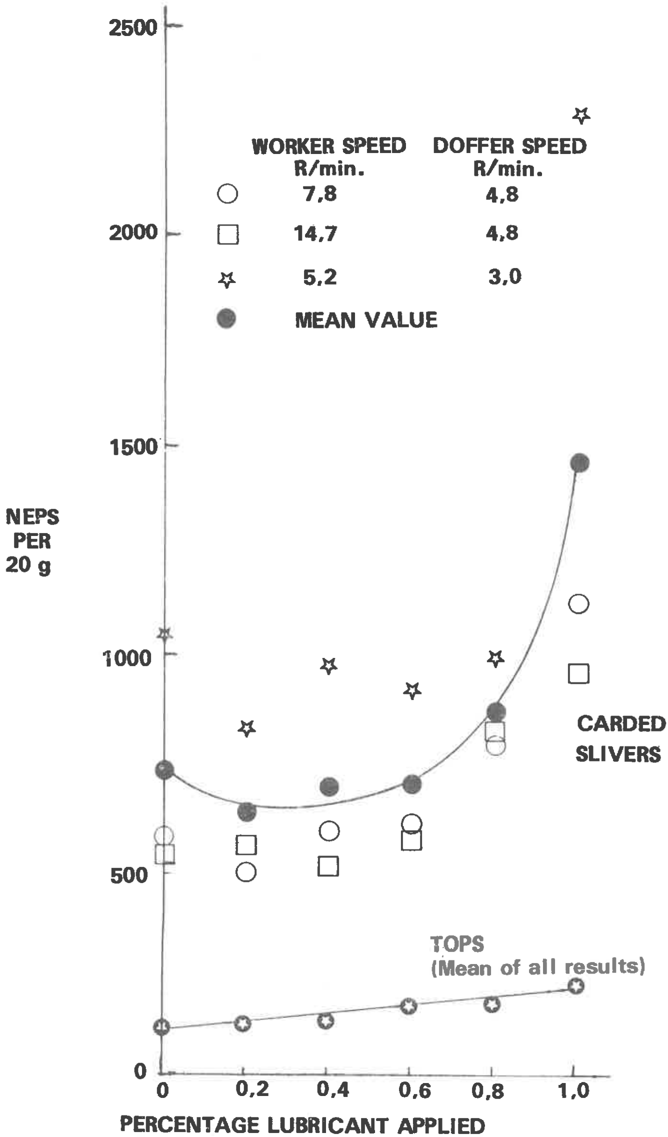

FIGURE 4

The effect of various levels of application of lubricant to 50/50 wool/cotton blends before carding on number of neps in the carded slivers and tops

From Figure 4 it is clear that an application of more than 0,6 *per cent* of lubricant to the blend before carding resulted in a deterioration in the nep count of the carded slivers. This deterioration tended to accelerate as the amount applied was increased above this level. Application levels of between zero and 0,6 *per cent* might have improved the nep count slightly with an optimum indicated at about 0,3 *per cent.* When the speed of the workers was doubled the effect upon the nep count of the carded slivers appeared to be insignificant, but when the delay factor of the card was significantly reduced by slowing down the doffer, and the worker speed was also reduced, the number of neps in the carded slivers increased significantly. Perhaps the severity associated with the increased duration of carding resulted in an increase in the breakage of cotton fibres which in turn increased their propensity to form neps.

From the point of view of the number of neps in the tops it is clear from Figure 4 that the least number of neps was found in the tops which were produced from the blend which was not lubricated, and the number of neps increased steadily as the degree of lubrication increased.

Combing Performance:

The effect of various application levels of lubricant to 50/50 wool/cotton blends before carding on the percentage noil obtained during combing is shown in Figure 5. Individual results are given for the three different combinations of worker and doffer speeds and the mean values, together with a visual best fit curve, are also shown.

From Figure 5 it can be seen that the amount of lubricant which was applied to the blend prior to carding had a profound influence on the percentage noil obtained during subsequent combing. An application of as low as 0,2 *per cent* produced a significant improvement in percentage noil in all cases. When both the doffers and the workers were at the slowest speeds selected the percentage noil tended to deteriorate. The mean values of all the results obtained indicated that on average, an application level of about 0,6 *per cent* gave optimum results but this conclusion might have been affected by the high value obtained when one *per cent* of lubricant was applied and the lowest worker speed was used.

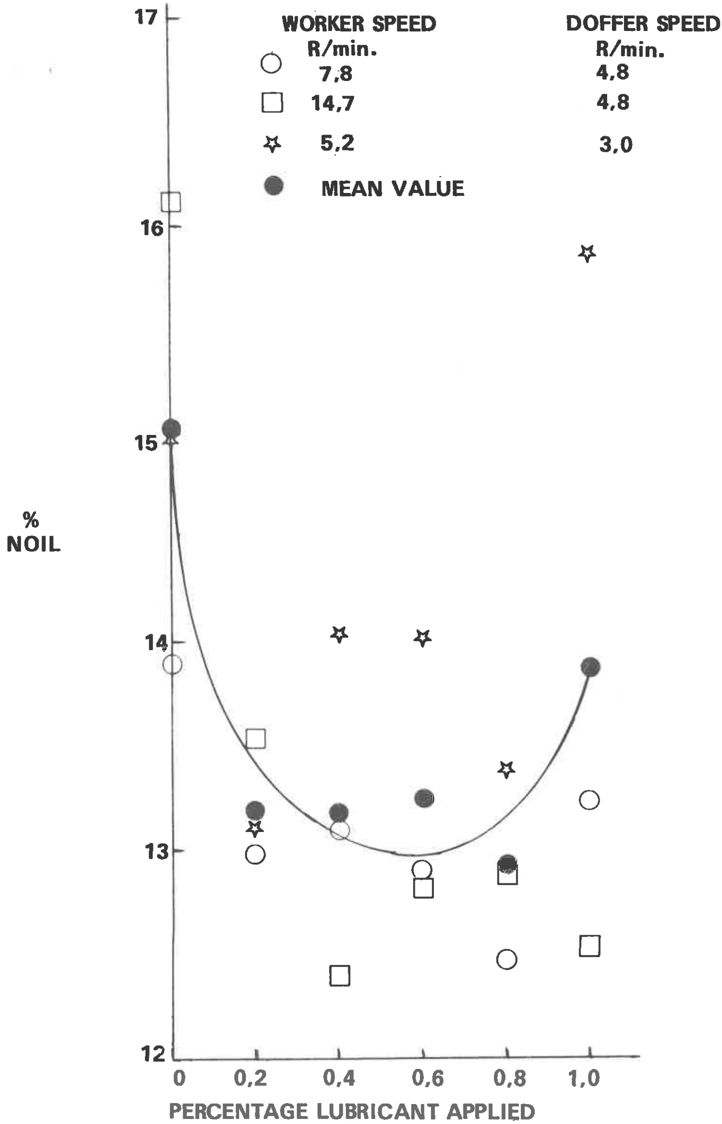

FIGURE 5

The effect of various levels of application of lubricant to 50/50 wool/cotton blends before carding on the percentage noil obtained during combing

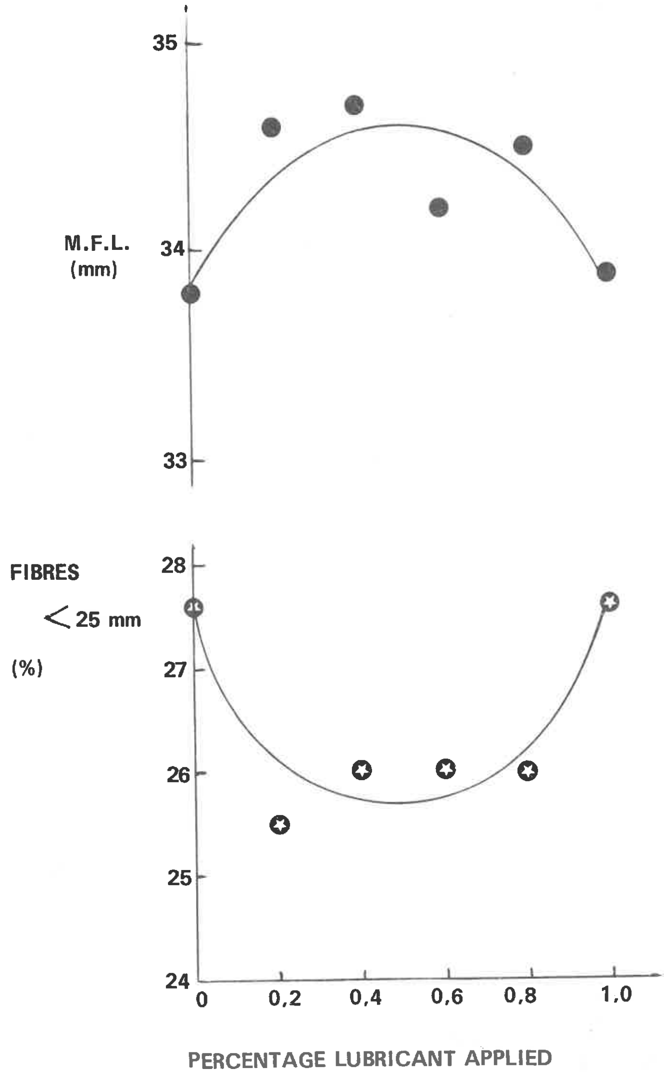

FIGURE 6

The effect of various levels of application of lubricants before carding to 50/50 wool/cotton blends on the mean fibre length of the top and the percentage of short fibre in the top

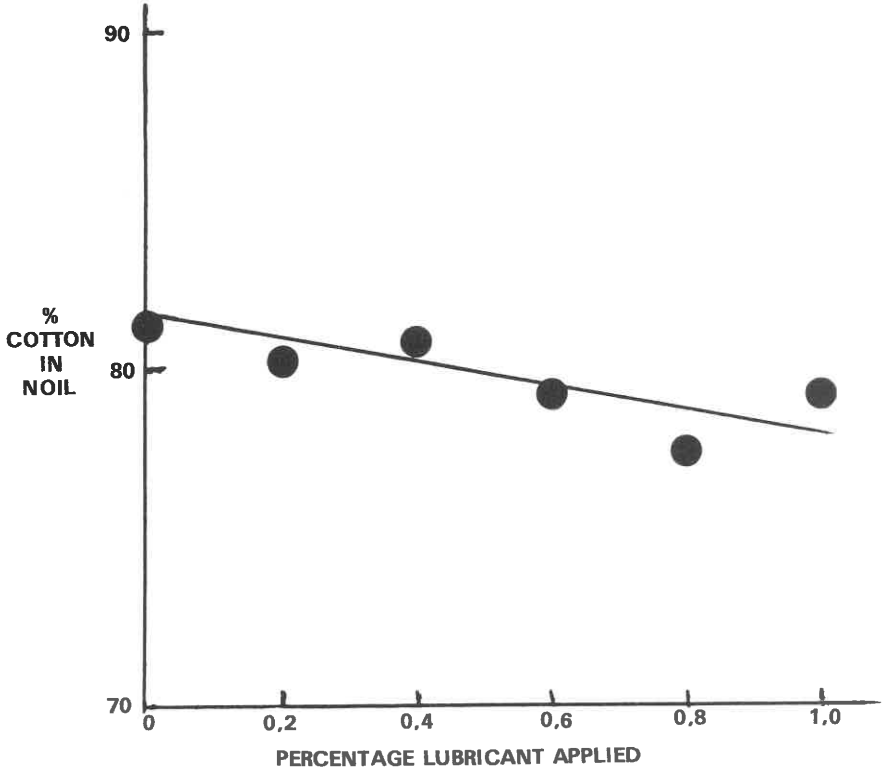

FIGURE 7

The effect of various levels of application of lubricant before carding to 50/50 wool/cotton blends on the separation of cotton fibres into the noil during subsequent combing

The mean fibre lengths of the tops which were produced from the 50/50 wool/cotton blends when various amounts of lubricant were applied to the blends before carding, together with the percentages of fibres shorter than 25 mm, are shown in Figure 6. From this figure it is clearly evident that when zero or one *per cent* of lubricant was applied the number of short fibres in the top was greater and the mean fibre length of the top was less than when an intermediate amount of lubricant was used. The tendencies shown in Figure 6 corroborate that for percentage noil shown in Figure 5. From these results a suitable choice for the level of lubrication would appear to be about 0,5 *per cent.*

TABLE VI

COMBING PERFORMANCE OF THE INDIVIDUAL COMPONENTS OF 50/50 WOOL/COTTON BLENDS CARDED AFTER THE APPLICATION OF VARIOUS PERCENTAGES OF LUBRICANT

Percentage Lubricant Applied	Percentage Noil	
	Comprising Cotton Fibres	Comprising Wool Fibres
0	12,20	2,81
0,2	10,61	2,60
0,4	10,67	2,52
0,6	10,51	2,74
0,8	10,03	2,89
1,0	11,00	2,89

The effect of various levels of application of lubricant before carding on the separation of wool and cotton fibres during combing is shown by the results of the chemical analyses carried out on the noils which are presented in Figure 7. When the amount of lubricant applied was increased the proportion of cotton fibre which found its way into the noil decreased. Subsequent chemical analyses carried out on the tops showed that in this series of experiments the blend ratio of the slivers which were combed was approximately constant in all cases. Average results indicated a reduction in the cotton content of approximately five *per cent* absolute from the value pertaining to the blend entering the card to that pertaining to the finished top.

Combing performances of the individual components of the blends were calculated from the above results and are presented in Table VI. From this table it is clear that lubrication of the blend at a level of as low as 0,2 *per cent* resulted in an improvement in the combing performance of both cotton fibres and wool fibres. Optimum performance occurred at a level of application of between 0,2 and 1,0 *per cent* in both cases. A suitable choice would again appear to be about 0,5 *per cent*. Of particular interest is the fact that the improvement in the performance of the cotton component due to lubrication exceeded that of the wool component.

TABLE VII
YARN PROPERTIES OF THE 55/45 WOOL/COTTON BLEND AND EXPERIENCE VALUES FOR WOOL AND COTTON YARNS

YARN PROPERTY	55/45 WOOL/COTTON YARN	Sawtri experience values for worsted yarns of 21 tex spun from SHORT WOOL of about 48 mm m.f.l. and 21,4 μm m.f.d.	USTER EXPERIENCE VALUES FOR AVERAGE YARNS MADE FROM:		
			Worsted Wool	Carded Cotton	Combed Cotton
Breaking strength (gf)	191	125	–	–	–
Extension (%)	5,6	12,1	–	–	–
Irregularity CV (%)	22,7	22,5	19,7	19,1	15,0
Thin places per 1 000 m	371	388	270	82	15
Thick places per 1 000 m	239	252	90	430	50
Neps per 1 000 m	36	21	23	385	57

Spinning performance of 55/45 Wool/Cotton Blend:

Spinning of the 55/45 wool/cotton blend was considered satisfactory from the point of view of the end breakage rate. This was found to be 3 per 100 spindle hours. The results of the various physical tests which were carried out on the yarns are given in Table VII. Also given in Table VII are the Uster experience values for the irregularity of average yarns made from carded cotton and combed cotton and average values for a wool worsted yarn [(3)]. Experience values for SAWTRI wool worsted yarns spun from *short wool* on the same set of machinery used for this investigation are also given [(4)].

It is clear that the *breaking strength* of the 55/45 wool/cotton yarn was superior to that of a normal worsted yarn but that the extension was considerably lower. With regard to irregularity, thick and thin places and neps the results for the 55/45 wool/cotton yarn were close to those experienced at SAWTRI on 100% wool yarns made from short wool and processed on the same machinery. The results were, however, inferior to the *Uster* experience values for average *worsted wool yarns* and for combed *cotton yarn* in all cases except for the nep count of the combed cotton which was slightly higher. Whilst the Uster experience values for carded cotton are better than the values obtained on the 55/45 blend in respect of irregularity and thin places, the reverse was found in respect of thick places and neps. It is clear from these results that the irregularity of the yarn needed improvement but that the neppiness was satisfactory. The appearance of the yarn conformed subjectively to Grade A standards of the A.S.T.M. for carded and combed cotton yarns of the same linear density, but the lower-than-normal neppiness of the yarn might have influenced judgement to some extent.

The investigations showed that 50/50 blends of wool and cotton could be processed successfully on the worsted system up to the top stage at production rates of about 50 to 60 *per cent* that for wool alone. Significant improvements in performance were possible by lubricating the blend and it is suggested that higher production rates may be possible by selecting cottons of lower nepping potential.

Worsted type yarn (21 tex Z860) composed of 55/45 wool/cotton was successfully spun from *re-combed* tops originating from the above investigations. The tops were drawn and spun on conventional worsted equipment after suitable adjustments to the settings. End breaks were only 3 per 100 splindle hours. The yarn produced had a good appearance, similar to that of a Class A (ASTM standards) cotton yarn. The irregularity was higher than that of average cotton yarns or average worsted yarns, but it was equal to that previously obtained on short stapled wool spun on this equipment. A slightly longer top would probably have helped to improve the irregularity. The breaking strength of the yarn was superior to that of a normal worsted yarn but the extension was considerably lower.

ACKNOWLEDGEMENTS

The author wishes to thank the staff of the departments of Worsted Carding and Combing, Spinning, Cotton Processing, Textile Physics and Testing Services for technical assistance during the course of this investigation. Permission by the S.A. Wool Board to publish this paper is gratefully acknowledged.

THE USE OF PROPRIETARY NAMES

The fact that proprietary names have been mentioned in this report does not in any way imply that SAWTRI recommends them or that there are not substitutes which may be of equal value or even better.

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ISBN 0 7988 0415 7

Published by
The South African Wool and Textile Research Institute
P.O. Box 1124, Port Elizabeth, South Africa,
and printed in the Republic of South Africa
by P.U.D. Repro (Pty) Ltd., P.O. Box 44, Despatch