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SOME ASPECTS OF THE SPINNING OF MOHAIR ON THE FRENCH SYSTEM

by

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ABSTRACT

A coarse type of mohair (BSFH; 37 micron) was processed on the French system. The influence of regain, small amounts of wool added to the mohair and additives on the spinning performance was investigated. A relation between the withdrawal force of the sliver, spinnability, and the yarn strength was established.

INTRODUCTION

Most publications on the processing of mohair deal with the Bradford system, operating on the "draft-against-twist" principle.

Villers[1] outlines a typical Bradford processing layout. She refers to a 50% relative humidity (at 21°C) as being satisfactory, yet stresses the importance of cellaring before and after drawing. Apart from stating that oil is added during the fourth passage of top preparing, additives are not discussed. It is suggested that the problem of loop-like "crackers" often present in mohair yarns, can be overcome by drying in the hank after a wet process. Recipes are also given to produce loop and curl yarns.

Barmby[2] found that although the spindle speed and the number of windings have a considerable effect on the number of yarn faults and on the hairiness of the yarn, neither seems to have any effect on the lustre of the fabric woven from the yarns. Hardly any difference in appearance was noticeable between yarns spun on a flyer and on a ring frame, spindle speeds being similar.

On a previous occasion[3] spinning trials were conducted on the Continental system with blends of kid mohair and a 64's merino wool. The influence of yarn count, blend composition, twist factor and spindle speed on the number of ends down, yarn breaking strength, elongation at break and levelness, was investigated.

About 80% of the South African mohair clip consists of the coarser types[4] (coarser than 36 micron) and accounts for only about 50% of the revenue. This is a disadvantage which can be obviated to a considerable extent by research into the potentialities of the coarser types. Consequently the two types used in this experiment fall into this category.

All trials were conducted on the Continental system. An effort was made to analyse the influence of the regain of the mohair on the number of ends down in spinning. A few mohair/wool blends were made up to evaluate the influence of small amounts of coarse wool on the spinning performance.

Only false twist is employed on the Continental system and since mohair inter-fibre cohesion is very low, considerable time was devoted to means of obtaining a more coherent fibre stream, strong enough to withstand processing tensions, keeping in mind that the yarns thus obtained must be acceptable to the customer as regards price, quality and aesthetic properties.

EXPERIMENTAL

Raw materials

The relevant details of the two mohair types (BSFH and BSH) and the two wools (Corriedale and Crossbred) are given in Table I.

TABLE I

Details of mohair and wool used

	diameter (micron)	length (cm)
BSFH	37	7.9
BSH	40.3	10.4
Corriedale	26	7.8
X-bred	30	6.1

Preparing

Three gillings with the number of ends up being equal to the draft ensured a good blending of fibres and distribution of additives. Gilling and drawing machine settings were identical to those described in a previous publication[3].

Water was sprayed on during gilling to investigate the influence of moisture content on the performance of BSFH mohair. The slivers requiring the highest moisture content were sprayed three times and those requiring less water were sprayed once or twice. Some slivers were only spun a day or two after having lost some condition. The roving with the lowest amount of moisture was partially dried by hot air.

All regain tests were performed on the roving employing the CSIRO direct reading regain tester. Some tests were checked by using the oven drying method and results showed a fair correlation. About 1% Leomin KP (Hoechst), which has antistatic properties was applied to the mohair during topmaking.

Dealing with the influence of Corriedale and Crossbred wools blended with the BSFH mohair, blends were made up having 10, 25 and 40% of each of the two wools, respectively. The mohair and wool tops were gill blended three times before drawing was commenced; as before, the mohair contained some 1% Leomin KP. Some water was also sprayed on during the first gilling.

In the third part, where the influence of additive on the processing performance was analysed, the BSFH mohair tops were backwashed twice to a free fatty matter content of about 0.4% before being spread out on a flat surface and the requisite emulsion sprayed on by means of an atomiser. After about half the sliver had been sprayed, it was turned over so that the other side could also be sprayed. The treated slivers were left under prevailing atmospheric conditions of 60% R.H. and 20°C for at least 24 hrs after which they were gilled three times before drawing was commenced.

The additives used were Lissapol NX (I.C.I.), Cirrasol (I.C.I.), Leomin KP (Hoechst), Durosil (Hansawerke) with Topsol oil (Price), and Silic (Hansawerke). All these exhibit antistatic properties with Leomin KP and Cirrasol, being softening agents as well. Durosil and Silic are reputed to increase interfibre friction. The amounts of these additives sprayed on are shown in Tables VI and VIII.

Initially, the amounts of additive sprayed on corresponded more or less to those prescribed by the manufacturers, except in the case of Durosil (with Topsol), where three amounts were sprayed on (see Table VI).

Because of the interest in the influence of oil plus additive mixture, a second trial was made in which all the lots contained 0.75% of oil plus the additive. (see Table VIII).

The final test was made on a lot sprayed with what was considered an optimum amount of oil and the best additive.

Drawing

Three gill drawings followed by a high drafter concluded the drafting stages, ending with a roving of 820 tex. This rather heavy roving is necessary to reduce roving breaks between bobbin and back roller on the spinner. Drawing details are compiled in Table II.

TABLE II

Draft Plan

Machine	Weight in	Ends-up	Draft	Weight out
Intersector	30.25 ktex 575 dr/40 yd	4	5.5	20.4 ktex 420 dr/40 yd
Intersector	20.4 ktex 420 dr/40 yd	4	6	13.6 ktex 280 dr/40 yd
Intersector	13.6 ktex 280 dr/40 yd	4	6.5	8.2 ktex 170 dr/40 yd
Drawbox	8.2 ktex 170 dr/40 yd	1	10	820 tex 17 dr/40 yd
Spinner	820 tex 17 dr/40 yd	1	12 18.5	68 tex; 1/13's w.c. 44 tex; 1/20's w.c.

After the three blending gillings and one draw gilling, a sliver sample was taken for withdrawal force measurements as described by Kruger[5].

The drawing performance of each lot was recorded with regards to the number of roller lappings and general behaviour.

Spinning

All yarns were spun on a Rieter worsted spinning machine. The number of ends down and roving breaks were recorded. The latter is relevant when mohair is processed due to the low cohesion.

The count and twist combinations were selected in such a way so as to obtain a fairly high frequency of ends down whereby the differences between lots under consideration were enhanced.

With this proviso it was found that a 68 tex yarn (1/13's w.c.) having 400 t.p.m. (10 t.p.i.) and a 44 tex yarn (1/20's w.c.) having 440 t.p.m. (11 t.p.i.) were satisfactory for spinning 100% mohair and mohair/wool blends, respectively. In most cases six spindles were run for at least 20 min. New travellers were used for each lot because it was considered that some additives containing silicic acid may cause extra traveller wear. It should be noted that all yarns were spun on an empty tube starting at the lowest point, under which conditions end break frequencies are usually high. The variable speed adjustment on the spinner was disconnected, ensuring a constant spindle speed.

Yarn testing

All yarns except those spun for the regain analysis were tested for strength and extension at break on the Uster Dynamometer. Yarn levelness was also recorded on the Uster evenness tester.

RESULTS AND DISCUSSION

Influence of regain

The spinning performance of mohair rovings containing different amounts of regain is given in Table III. Six spindles were run for 20 min at 6000 rpm.

TABLE III

Spinning* breaks at tested regains

Lot	Roving Breaks	Yarn Breaks	Regain %
1	0	14	19.7
2	1	13	17.6
3	0	2	16.4
4	0	5	16.2
5	2	1	15.2
6	0	5	10.7
7	0	10	3.4

*100% BSFH mohair, spun into a 68 tex yarn having 400 t.p.m. at 6,000 rpm; yarn breaks recorded per 120 spindle min.

It will be seen that the best spinning performance is obtained at a regain of about 16%. Interesting to note is the increase in the number of ends down when the regain exceeds 16%, but at this stage no explanation is offered for the increase in ends down with an increase in the regain.

Spinning performance of mohair/wool blends

The spinning performance of the blends was so much better than that of 100% mohair that the finer count (44 tex) with a lower twist factor (440 t.p.m.) had to be spun at a spindle speed of 8,000 rpm in order to obtain a convenient number of breaks. Under these conditions the pure mohair proved virtually impossible to spin, breaking about five times more than the 10% Crossbred (X-bred) blend. In Table IV the number of breaks is given for the various blends. The improvement in spinning performance persists with increased wool content.

TABLE IV

Breaks* for various mohair/wool blends

BSFH mohair containing	Type of break Roving	 Yarn
No wool	—	about 100
10% X-bred	2	12
25% X-bred	0	5
40% X-bred	0	2
10% Corriedale	3	2
25% Corriedale	0	2
40% Corriedale	0	0

*Seven spindles at 8,000 rpm for 30 min ; 44 tex with 440 t.p.m.

Also worth noting is the better spin obtained with the Corriedale blends as compared with those containing X-bred wool. This is presumably due to the Corriedale fibres being finer and longer.

Yarn analysis

The statistics of yarns from the six blends, yarn from old stock Corriedale/BSFH mohair from the same raw material and yarn spun from Corriedale/BSF mohair are given in Table V.

TABLE V

Yarn characteristics

Sample	Uster CV %	Breaking strength (g)	Extension at break (%)	Count (tex ; w.c.)
10% Corriedale/ 90% BSFH	23.2	211.4	16.2	44 tex, 1/20's w.c.
25% Corriedale/ 75% BSFH	23.8	196.8	14.4	44 tex, 1/20's w.c.
40% Corriedale/ 60% BSFH	21.2	272.2	16.7	44 tex, 1/20's w.c.
10% X-bred/ 90% BSFH	22.5	192.9	15.4	44 tex, 1/20's w.c.
25% X-bred/ 75% BSFH	22.0	200.2	15.2	44 tex, 1/20's w.c.
40% X-bred/ 60% BSFH	21.5	219.8	13.8	44 tex, 1/20's w.c.
25% Corriedale/ 75% BSFH (old stock)	24.4	218.2	15.3	44 tex, 1/20's w.c.
25% Corriedale/ 75% BSH	24.1	158.2	12.8	44 tex, 1/20's w.c.
25% Corriedale/ 75% BSH (Draft 20)	18.9	525.0	24.3	88 tex, 1/10's w.c.
25% Corriedale/ 75% BSH (Draft 10)	18.3	512.3	22.0	88 tex, 1/10's w.c.

With reference to blend composition there is evidence that an increase in the wool content increases the yarn strength. Extension at break decreases with higher proportions of mohair. This is in accordance with previous work[3] provided the wool fibre is finer than the mohair. Yarn regularity is also higher with blends having more wool. Interesting too is the reduction in yarn strength when a coarser mohair, BSH, is used instead of BSFH. This stresses the importance of fibre diameter.

With two roving lots made from the same raw materials (75% BSFH and 25% Corriedale) differing in age only, it was possible to investigate the influence of roving age. There is no evidence that yarn strength or regularity improved materially due to roving ageing. The two 75% BSH yarns spun with 10 and 20 of a draft showed very little difference in the measured properties. The two yarns were knitted up identically and no subjective difference in lustre between the two fabrics was visible. These results are contrary to the belief of some spinners in the Bradford trade but confirm recommendations by an additive manufacturer[6] who has experience of mohair processing on the Continental system, that drafts of more than 20 be employed.

The influence of additives

In the first section of the additive investigation, several types available on the market were tried on BSFH mohair. The amount of each type applied was more or less as described by the manufacturers except in the case of Durosil where three levels of application were tried.

Table VI shows the data on the gilling, roving and spinning performances.

TABLE VI

The influence of additive on the processing* of mohair into yarn

Additive	Gilling behaviour	Roving behaviour	Roving breaks	Yarn breaks	Withdrawal force (kg/g)
3% Leomin KP	Good	Good	3	6	1.63
0.12% Lissapol NX	Good	Good	0	8	1.15
0.4% Silic	Slightly static	Lapping (2)	0	3	1.65
0.2% Durosil + 0.1% Topsol	Reasonable	Reasonable	0	6	1.48
1% Durosol + 0.5% Topsol	Parchment on front roller	Good	0	1	1.62
3% Durosil + 1.5% Topsol	Parchment on front roller	Lapping (2)	0	0	1.99

*100% BSFH mohair, spun into a 68 tex yarn having 400 t.p.m. at 6,000 rpm; yarn breaks recorded for six spindles running 20 min.

The gilling performance was satisfactory with the more common additives but the mohair treated with Silic, which increases the interfibre friction, was too lively. Possibly due to the oil not being equally distributed throughout the sliver the Durosil treated fibres were not behaving very well during the initial gilling stages. Parchment was wrapped around the front roller and this reduced lapping considerably. However, a leather apron around the top front roller of the gill box should alleviate this problem.

The roving making was described as "Good" for the lots being sufficiently antistatic without having too much oil. The spinning performance was judged "Good" for the lots treated with Silic and 1% or more of Durosil.

The withdrawal forces seemed to be related to the number of ends down. The regression of the yarn breaks (y) and the withdrawal forces (x) is given by

$$y = -9.82x + 19.58$$

with a correlation coefficient of –0.846 with four degrees of freedom.

It is important, however, to consider not only the interfibre friction which must be increased but also the cohesion necessary to make this increased friction effective. In the case of Durosil the extra cohesion is probably obtained through the addition of oil. Apart from the antistatic properties of an additive it will also be advantageous if the additive had hygroscopic properties which should assist spinning even further.

The influence of the additives was pursued further and it was found, as Table VII shows, that the strongest yarns broke down less frequently than the weak ones. The regression line of the number of ends down (y) and the yarn strength (x) is given by

$$y = -0.05x + 17.61$$

A correlation co-efficient of –0.95 which, with four degrees of freedom, is significant at the 1% level.

TABLE VII

Influence of additives on yarn characteristics*

Additive	Yarn breaks (per 120 spindle min)	With-drawal force (kg/g)	Yarn regularity (CV %)	Yarn strength (g)	Yarn elongation (%)
3% Leomin KP	6	1.63	23.9	244.9	17.9
0.12% Lissapol NX	8	1.15	22.7	200.6	17.7
0.4% Silic	3	1.65	20.7	295.2	20.2
0.2% Durosil + 1% Topsol	6	1.48	23.3	220.8	17.3
1% Durosil + 0.5% Topsol	1	1.62	22.9	299.4	21.1
3% Durosil + 1.5% Topsol	0	1.99	22.8	364.2	21.5

*100% BSFH mohair, spun into a 68 tex yarn having 400 t.p.m. at 6,000 rpm.

With the second investigation into the influence of additives, all lots contained 0.75% of Topsol oil. Table VIII shows the data on the gilling, roving and spinning performance and withdrawal forces.

TABLE VIII

The influence of additive in processing* of mohair into yarn

Additive	Gilling behaviour	Roving behaviour	Roving breaks	Yarn breaks (per 120 spindle min)	Withdrawal force (kg/g)
0.12% Lissapol NX + 0.75% Topsol	Good	Poor	4	22	0.67
1% Leomin KP + 0.75% Topsol	Good	Good	0	10	0.63
0.4% Silic + 0.75% Topsol	Parchment on front roller	Poor	0	4	1.10
1% Durosil + 0.75% Topsol	Good	Satisfactory	0	8	0.90
1% Cirrasol + 0.75% Topsol	Good	Satisfactory	0	10	0.73
1.2% Durosil + 0.4% Topsol	Good	Good	3	3	1.12

*100% BSFH mohair, spun into a 68 tex yarn having 400 t.p.m. at 7,000 rpm; yarn breaks recorded for six spindles running 20 min.

It was found that whereas the first test was carried out at a spinning speed of 6,000 rpm, it was now necessary to increase the speed to 7,000 rpm. The good spinning performance obtained by adding Silic and oil is noteworthy. This lot was difficult to handle during gilling and roving and the best overall results were obtained from the lot containing Durosil. Again there seems to be a relation between the ease of spinning and the withdrawal force, the latter being higher for the lots which performed better during spinning.

From the experience gained so far it was decided to try one last lot, sprayed with 1.2% of Durosil and 0.4% Topsol. The spinning performance improved even further, only three ends breaking in 20 min with a spinning speed of 7,000 rpm.

TABLE IX

Influence of additive on yarn characteristics

Sample	Average Uster (CV %)	Breaking load (gm)	Extension at break (%)	Withdrawal force (kg/g)
.75% Oil	24.4	212.0	18.4	0.63
.4% Silic .75% Oil	23.8	316.0	19.32	1.10
.5% Cirrasol .75% Oil	23.6	173.6	18.2	0.73
1% Durosil .75% Oil	23.0	215.4	17.18	0.90
1.2% Durosil .4% Oil	22.7	320.9	17.8	1.12
1% Leomin KP .75% Oil	23.8	182.6	17.9	0.63
0.16% Lissapol NX .75% Oil	23.0	218.6	18.0	0.67

In Table IX the characteristics of the yarns spun in the second trial are given. Once more yarn strength and withdrawal force of the sliver are related, those with higher withdrawal forces resulting in yarns with a higher breaking load. The regression line of the withdrawal force y and the breaking load x is given by

$$y = 0.073x + 0.003$$

with a correlation coefficient of 0.89 (significant at the 1% level). A regression line was also established to obtain a relation between the withdrawal force y, and the number of yarn breaks z. The relation was

$$y = 1.089z - 0.024$$

with a correlation coefficient of –0.76 (not significant at the 2% level).

The general conclusion is that an increase in interfibre friction, which can be measured by means of the withdrawal force, enables a stronger yarn to be spun with greater ease, a fact with which mohair spinners will be familiar.

No clear trend is noticeable from the Uster values. According to standards drawn up by Hunter[7], a wool hosiery yarn of the same fibre diameter and count should have a C.V. of just over 20%. The mohair yarns are all somewhat more irregular which is probably due to their unique characteristics.

Processing observations

From experience gained so far a few general points will be worthwhile noting when processing mohair on the French system.

Backwashing improves the lustre of mohair. The backwashing of mohair is risky and in order to make such a proposition more practical, an increase in the twist of the tops would ensure a more trouble-free passage through backwashing.

Great care must be taken during gilling to ensure that the slivers going into the fallers are equally spaced. If the concentration of fibre is, say, more on the sides, the resultant sliver emerging from the front rollers will be stronger on the outside than in the centre region. During the next process when the sliver is pulled out of a can, the centre part of the sliver will sag out, causing the sliver length to be longer down the middle than down the sides. If the sliver spacing going into the gill box is really bad, the sliver may split up in the subsequent process causing justifiable concern.

Due to the lack of control, irregularities can easily be introduced and the number of passages must, therefore, be limited. Schütte and Casteel[6] recommend not more than three drawing stages. It is also important to make a reasonably strong roving. Apart from the additional strength obtained by using additives, a fine, twistless roving is too weak to withstand the strain when it is pulled off the bobbin during spinning. The amount of roving per bobbin must also therefore, be limited because a heavy package will possess a higher inertia. The creel construction also plays a rôle and the umbrella type is probably the best where no fibres can constrict the movement of the slowly rotating package. Care must be taken at all times to ensure that the package can revolve easily.

Mohair yarns are known for their hairiness. The higher the spinning speed the more hairy the yarn. Excess hairiness is to be guarded against because it interferes with the traveller movement. Spinning speeds should therefore not be excessive. If the yarn package is too thick, the hairs on the package push the traveller forward, causing it to rotate at such a high speed that no winding-on takes place. The balloon, therefore, gets bigger until it is snagged. This problem is overcome by using a heavier traveller than usual, which will increase the friction, assisting the traveller to maintain the lag necessary for winding-on to take place. By decreasing the package diameter the hairs will interfere less with the traveller movement, thereby reducing this problem even more.

It is known[2] that the winding of mohair yarns interferes with the fibre configuration. The number of winding operations should be kept down to a minimum and dyeing should preferably not be executed in the yarn state.

SUMMARY

The spinning performance of BSFH mohair (37 micron) on the Continental system was investigated. It was established that a regain value of about 16% was necessary for a reasonable spinning performance. The performance improved markedly when as little as 10% of a coarse wool (26 micron or 30 micron) was mixed with the mohair.

The influence of various additives during spinning was also investigated. Additives with antistatic properties which increase interfibre friction and sliver cohesion gave the best results. A measure of the performance during spinning can be obtained by measuring the withdrawal forces of the slivers.

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