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Studies on Pigmented Wools Part II: Processing Performance of Willeyed Karakul during Topmaking

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STUDIES ON PIGMENTED WOOLS, PART II: PROCESSING PERFORMANCE OF WILLEYED KARAKUL DURING TOPMAKING

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ABSTRACT

*Five lots of sorted karakul, varying in seed content and mean fibre length, were processed into worsted tops and the raw fibre properties and processing performance recorded. The raw fibre had low grease contents and high suint levels compared with merino wool, while the suint pH was found to be fairly alkaline. All five lots were willeyed prior to scouring. By direct measurement of the wool base of the wastes it was established that the processing losses were substantially higher than the IWTO processing allowances associated with merino wools. The tops were about 3—4 μ*m coarser than the raw fibre.

INTRODUCTION

The Karakul is a fat-tailed breed of sheep which is indigenous to the arid areas between the Caspian sea and Turkey. The word Karakul is derived from an ancient Assyrian word *Kara-Gjull* meaning "black rose"[1], an indication of the aesthetic appeal which is synonymous with the pelts obtained from karakul lambs. In 1907 the German authorities in South West Africa imported two rams, seven ewes and three lambs from Austria and founded the karakul industry in this area. Today some 5 million of these animals are found in the arid areas of southern South West Africa/Namibia and the North Western Cape Province.

Although the karakul industry is centred around the production of pelts from day-old lambs, the hair shorn from the adult animal represents a sizeable portion of the shorn wool production marketed in South Africa. The production for the 1978/79 season was 7,1 million kg, or 7,2% of the total clip[2]. The use of karakul as a textile fibre is, however, limited and it is considered as a by-product of the pelt industry. This is due mainly to the fact that the fibre is coarse, dull and coloured, the latter because of melanin pigmentation. The colours in which natural karakul occurs varies from a whitish grey to chocolate brown and black. The fibre can, however, be used in tufted carpets and over the years it has been possible to build up a substantial export market for karakul. This market has, however, virtually disappeared, with the result that only 46,6% of the total offerings of karakul of the 1978/79 season could be sold[1]. This acute situation has accentuated the urgent need for research and product development in order to find a wider range of end products into which surplus stocks of karakul could be channelled.

In addition to recent studies on other pigmented wools[3, 4], some limited studies have also been carried out at SAWTRI to find alternative end uses for karakul. For example, Robinson and Slinger[5] investigated the use of karakul in the production of interlinings, while Robinson, Ellis and Van der Merwe[6] studied the use of karakul for curtaining and upholstery fabrics using a Co-we-nit machine. Almost the entire interlining industry today, however, is based on the use of synthetic fusible products, while the Co-we-nit principle of fabric production never made a significant impact on either the local or overseas markets. It was decided, therefore, that other end-uses should be sought and that, as a starting point, a systematic study of the properties and processing of karakul be made in order that such projects may be put on a sound scientific basis. This report deals with some of the properties and processing of five selected types of sorted karakul up to the top stage.

MATERIALS AND METHODS

Raw Materials

Five types of sorted karakul, varying in seed content and appraised length were selected for this study. The official Wool Board trade type descriptions are given in Table I.

TABLE I

TYPE DESCRIPTIONS OF FIVE SELECTED LOTS OF SORTED KARAKUL

CODE	TYPE	TRADE DESCRIPTION
KA 1	616	Black/Brown, all lengths, carbonising
KA 2	625	Grey, 50—75 mm, free to nearly free
KA 3	626	Grey, below 50 mm, free to nearly free
KA 4	603	Black/brown, 65—115 mm, free to nearly free
KA 5	632	Grey, 50—75 mm, medium seed.

Each lot (average mass approximately 149 kg) was blended by hand, repacked and cored. Hand samples were also drawn for determination of the staple length as well as grease and suint contents, suint pH and methanol insoluble fraction of the grease. The mean fibre diameter of each lot was determined using the projection microscope method on core samples.

Willeying

Prior to scouring, all five lots were given a preliminary opening on a single cylinder willeying machine. The willeyed material was then repacked and cored again, for determination of the yield.

Scouring

The willeyed karakul was scoured in a one-foot wide four bowl Petrie & McNaught plant at a production rate of approximately 100 kg/hr (greasy). The temperature in the four bowls was maintained at 60°, 60°, 50° and 40°C, respectively while the corresponding detergent charges (®Berol Lanco) were 0,006% (v/v), 0,002% (v/v) and 0,0016% (v/v) for bowls 1, 2 and 3, respectively. No soda ash was used to reduce melanin bleeding to a minimum[7]. Each lot was scoured in a fresh liquor and dried at 78°C. The scoured product was tested for residual grease and regain prior to spraying with 3% water together with a sufficient amount of ®Bevaloid Fibre Lubricant 4027 to increase the residual fatty matter content to a level of around 1%.

Carding, Gilling and Combing

The material was carded on a double swift FOR Biella continental worsted card with the swift speed set at 115 rev/min . The card clothing type and density were those usually employed for processing merino wool (i.e. fillet clothing on the workers and strippers, metallic clothing on the breast, swifts and doffers). The settings and production rates at which the five lots were processed are given in Table II.

TABLE II

CARD SETTINGS AND PRODUCTION RATES

CARD VARIABLE	KA 1	KA 2	KA 3	KA 4	KA 5
Production Rate (kg/hr, nominal)	18	21	20	21	21
Worker setting (mm)*					
Breast	Packed	Packed	Packed	Packed	Packed
1st Swift (No. 4 worker only)*	0,91	0,91	0,91	0,91	0,91
2nd Swift (No. 4 worker only)*	0,56	0,56	0,56	0,56	0,56
Burr Beaters employed	1	—	—	—	—
Burr beater setting (mm)*	0,31	—	—	—	—
Regain before carding (%)	16,0	16,0	15,0	13,0	15,0

*Equivalent Imperial Standard Wire Gauges: 0,91 mm = 20
0,56 mm = 24
0,31 mm = 30

The card was run without material for 20 minutes prior to each experiment. The portions of card sliver produced during the first and last five

TABLE III

GILL SETTINGS

	KA 1			KA 2			KA 3			KA 4			KA 5		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Ratch (mm)	30	30	30	35	35	35	24	24	24	24	24	24	30	30	30
Doublings	8	8	4	8	8	5	7	7	4	7	7	4	7	7	4
Draft (nominal)	4	4,5	4,5	4,5	5	5,25	4	4,5	4,7	4	4,5	4,5	4	4,5	4,5

minutes of each run were discarded and the balance retained for further processing.

Preparatory gilling (3 passages) was carried out on a Schlumberger GNP intersecting gill box using metal fallers with a pin density of 5 pins/cm . During the first two gillings, the slivers were sprayed with water to increase the regain for combing to approximately 19%. The other important gilling variables are given in Table III.

The gilled slivers were combed on a Schlumberger PB26 rectilinear comb running at 130 nips/min . A top comb pin density of 30 pins/cm was selected to ensure as clean a top as possible and the cylinder was fitted with a Nitto Unicomb segment. The relevant comb settings, loading and production rates are given in Table IV.

TABLE IV

COMB SETTINGS AND PRODUCTION RATES

	KA 1	KA 2	KA 3	KA 4	KA 5
Gauge (mm)	32	32	30	30	30
Pre-feed (sprocket wheel)	21	21	21	19	21
Feed (mm)	4	5	4	5	4
Sliver Linear Density (ktex)	20	25	24	22	24
No. of ends	12	12	12	12	12
Comb Loading (ktex)	240	300	288	264	288
Production Rate (kg/hr)	10,1	10,6	9,8	9,9	10,5

The tops were finished by autolevelling twice to a final sliver linear density of 24 ktex .

Testing

The wastes collected during scouring (fibrous bowl waste), carding (fettlings, sweepings and burrs) and combing (comb shoddy) were cored collectively and tested for wool base.

All card- and gill slivers as well as the finished tops were tested for neps and vegetable particles using a Toennisen top tester. The finished tops were also tested for mean fibre diameter (projection microscope), mean fibre length (Almeter method) and dichloromethane extractable matter (column and tray method). Compressibility was tested by measuring the compressed height of a steamed top sample using the SAWTRI compressibility tester.

RESULTS AND DISCUSSION

Physical Properties of the Raw Karakul

Some of the physical properties of the raw karakul are given in Table V.

TABLE V

SOME PHYSICAL PROPERTIES OF THE RAW KARAKUL

Properties of the Raw Karakul	KA 1	KA 2	KA 3	KA 4	KA 5
Unstretched staple length (mm)	82	86	66	63	91
CV (%)	27	21	31	22	24
Mean fibre diameter (um)	27,4	31,6	26,2	28,4	30,0
CV (%)	44	43	47	47	44
Wool Base (%)	50,2	59,4	54,7	61,7	55,8
Vegetable matter, greasy (%)	2,8	0,6	0,4	0,5	1,6
Estimated commercial top and noil yield (%)*	56,6	68,8	63,4	71,7	64,1
Grease content (%)	4,9	3,8	4,9	3,6	4,5
Methanol insoluble fraction (%)	35,4	35,2	34,0	31,2	31,7
Suint content (%)	16,7	14,7	16,4	10,6	14,6
Suint pH	8,4	8,5	8,6	8,5	8,6

*Based on IWTO formula for merino wool

As expected, the mean fibre diameter values were fairly high as were the CV's of diameter (43—47%) compared with typical values of around 22% for merino-type wools. The measured staple length of the five lots also appeared to correspond in only two cases (KA 1 and KA 4) to the length specification given by the trade type description (see Table I).

Compared with typical values for a range of South African merino type wools, the grease levels, oxidised fraction of the grease, suint content and suint pH of the five lots of karakul were also different[8]. This is illustrated in Table VI.

TABLE VI

A COMPARISON OF KARAKUL AND WOOL IN TERMS OF SOME TYPICAL GREASE AND SUINT CHARACTERISTICS

	GREASE CONTENT (%)		METHANOL INSOLUBLE FRACTION (%)		SUINT CONTENT (%)		SUINT pH	
	Mean	CV(%)	Mean	CV(%)	Mean	CV(%)	Mean	CV(%)
Karakul (mean of KA1 — KA 5)	4,3	12,6	33,5	5,0	14,6	15,0	8,5	1,0
Wool*	14,5	20,0	44,8	17,3	7,7	30,6	6,9	10,5

*Ref (8)

The fairly low grease content of karakul and the high pH of the suint, together with the fact that a relatively large portion of this grease is "oxidised" implies that karakul is easily overscoured if due care is not taken with respect to, for example, detergent concentrations.

Willeying Results

The amounts of dirt and dust removed from the karakul during willeying and the effect of willeying on the wool base, vegetable matter and estimated top and noil yields are given in Tables VII and VIII, respectively.

TABLE VII

WILLEYING RESULTS

	KA 1	KA 2	KA 3	KA 4	KA 5
Total mass processed (kg)	151,5	147	153,5	145,5	148,0
Dust (kg)	0,35	0,35	0,4	0,4	0,4
Dirt (kg)	15,25	5,7	8,0	6,8	7,5
Invisible loss (kg)	1,4	0,5	0,6	0,3	0,1
Total loss (%)	10,2	4,5	5,9	5,2	5,4

TABLE VIII

THE EFFECT OF WILLEYING ON WOOL BASE, VM GREASY AND ESTIMATED TOP AND NOIL YIELD*

LOT	WOOL BASE (%)		VM GREASY (%)		ESTIMATED TOP AND NOIL YIELD (%)	
	Before Willeying	After Willeying	Before Willeying	After Willeying	Before Willeying	After Willeying
KA 1	50,2	49,6	2,8	1,7	56,6	56,8
KA 2	59,4	58,4	0,6	0,57	68,8	64,8
KA 3	54,7	53,1	0,4	0,43	63,4	61,4
KA 4	61,7	60,2	0,5	0,2	71,7	70,1
KA 5	55,8	55,4	1,6	1,0	64,1	63,9

*Based on original mass of raw fibre.

Table VII shows that the most seedy lot (KA 1) had, as expected, the highest loss during willeying. There was also a significant reduction in VM (greasy) after willeying (see Table VIII). Loss of *fibre* was also evident judged by the slightly lower figures for wool base and estimated commercial top and noil yields obtained after willeying.

Scouring Results

The scouring results are given in Table IX.

TABLE IX

SCOURING RESULTS

	KA 1	KA 2	KA 3	KA 4	KA 5
Detergent additions (excluding initial charge)	0	0	0	0	0
pH in bowl (1) at beginning of scour	7,7	7,6	7,7	7,7	7,7
pH in bowl (1) at end of scour	8,3	8,3	8,2	8,4	8,2
Scoured yield at 16% regain (% on original mass)	65,2	72,5	67,9	75,3	70,7
Residual grease (%)	0,3	0,1	0,1	0,1	0,1
Bowl waste (% on scoured)	0,5	0,4	0,5	0,7	0,4

Although neutral scouring conditions were employed it is obvious that there was a trend for the liquor in the first bowl to become alkaline, most probably due to the high alkalinity of the suint (see also Table VI). This makes it extremely difficult to contain melanin bleeding when scouring karakul. In addition, the very low residual grease levels of the scoured product illustrates the relative ease of scouring karakul, and consequently only very small initial additions of detergent would appear to be adequate.

The scoured yield of the five lots varied from about 65% to 75%, and was found to be appreciably higher than the average yield of 62%, quoted for the karakul produced during the 1978/79 season[9].

Carding, Gilling and Combing Results

The carding, gilling and combing results are shown in Table X.

TABLE X

CARDING, GILLING AND COMBING RESULTS

	KA 1	KA 2	KA 3	KA 4	KA 5
Card rejects (%)*	17,7	9,4	9,5	10,6	10,2
Card yield (%)*	83	91,5	91,3	90,2	90,6
Neps after carding (per 20 g)	37	13	62	18	26
VM after carding (per 20 g)	442	120	83	68	376
Neps after gilling (per 20 g)	23	8	17	11	11
VM after carding (per 20 g)	477	78	79	53	200
DCM extract (%)	0,6	0,5	0,6	0,5	0,6
Combing yield (%)*	97,7	98,7	103,2	97,4	98,7
Drycombed Top & Noil Yield (%)	53,6	65,5	63,9	66,1	63,2
Tear	10,9	10,8	6,4	7,8	11,6
Noil (%)	8,4	8,4	13,5	11,3	7,9
Mean Fibre Diameter of the Noil (μm)	26,1	27,2	25,2	27,4	27,8
Comb shoddy (%)*	3,8	3,2	3,1	3,9	1,5

*Calculated on scoured mass

The values of card rejects were the highest (and the card yield the lowest) in the case of the most seedy lot (KA 1), where a burr beater had to be used on the card (see Table III). As expected, the vegetable particle count after both carding and gilling was the highest for this lot followed by lot KA 5 which was of average seed content. In addition, the vegetable particle count appeared to decrease after gilling, suggesting that some removal of vegetable particles takes place even during preparation for combing. The combing tear and noilage of the five lots appeared to be rather a function of fibre length than of vegetable matter content. The two shortest lots (KA 3 and KA 4) had the lowest combing tears (6,4 and 7,8 respectively) and the highest noil values (3,5% and 11,3% respectively).

An estimate of the actual fibre losses incurred during processing was then obtained from the core test data of the wastes. These losses, expressed as wool base as percentage on the original raw mass, are given in Table XI.

TABLE XI

PROCESSING LOSSES DURING THE VARIOUS STAGES OF TOPMAKING (% WOOL BASE ON ORIGINAL MASS)

	KA 1	KA 2	KA 3	KA 4	KA 5
Willeying	0,6	1,0	1,6	1,5	0,4
Bowl waste	0,2	0,22	0,24	0,37	0,18
Card Waste	7,09	5,06	4,55	6,07	4,83
Comb Shoddy	1,5	1,71	1,49	2,24	0,71
Total	9,4	8,0	7,9	10,2	6,1
IWTO Processing Allowance	3,9	2,9	2,7	3,0	3,4

The actual processing losses were substantially higher than the IWTO allowances for merino wools, obtained from the core test data.

Properties of the Top

The various top characteristics are given in Table XII.

TABLE XII

PROPERTIES OF THE TOP

	KA 1	KA 2	KA 3	KA 4	KA 5
Mean fibre length (mm)	49,6	50,2	42	40,1	54,0
CV (%)	45,5	46,6	50,6	47,7	48,3
Mean fibre diameter (μm)	31,3	34,7	29,4	31,1	34,4
CV (%)	48,4	41,9	48,8	49,3	44,5
Tail length (mm)	93,4	93,6	82,9	72,9	104,7
Short Fibre Content (% < 25 mm)	7,4	10,2	16,5	17,5	8,1
Tail: Mean Ratio	1,88	1,86	1,97	1,80	1,94
Conversion Ratio	1,65	1,7	1,57	1,57	1,68
Neps (per 20 g)	0	0	1	1	0
VM (no per 20 g)	12	4	7	4	9
Resistance to compression (mm)	15,0	14,9	15,2	14,9	14,9

Table XI shows that although the CV (%) of length of karakul appears to be not much different to the values normally found for merino wools, the CV (%) of diameter was found to be, on average, almost twice that of typical values for a wool of about 32 μm[10]. Comparing the mean values of fibre diameter in the top with the mean fibre diameters of the raw karakul (see Table VI), the tops were from 2,7 μm to 4,4 μm coarser, suggesting that a high proportion of the processing losses consisted of the finer components in the karakul. The fact that the short, fine component is removed by the comb is illustrated by the observation that the mean fibre diameter of the noil was from approximately 1 to 4 μm finer than that of the raw fibre (cf Tables X and VI). The ratio between the tail length (i.e. that length which is exceeded by 5% of the fibres in the top) and the mean fibre length was found to be fairly high compared with merino wools[8], indicating the presence of long beard fibres in the tops. This characteristic, together with the high variability of fibre diameter could play an important part in determining the spinning properties of karakul.

The values of the other properties given in Table XII followed more or less the expected trends: the short fibre content was the highest for the two shortest lots while the vegetable particle count was the highest for the lot KA 1, which was originally the most seedy lot, followed by lot KA 5 which had been classed as "average seed". The lack of crimp in karakul was responsible for the low resistance to compression, which was again found to be appreciably lower than for merino type wools.

SUMMARY AND CONCLUSIONS

Five lots of sorted karakul, types 616, 615, 626, 603 and 632, were processed from the raw fibre to the finished top and the processing behaviour studied. The processing involved willeying, scouring, carding, gilling and combing on a worsted processing range normally associated with the processing of finer merino-type wools. Within practical limits the processing conditions were kept the same for all five lots, apart from small adjustments to some machine settings to suit the individual lots.

The high variability of fibre diameter was evident in both the raw fibre state as well as in the top, although the length variation in the top did not differ much from that of merino wools. The tops generally were coarser than the raw karakul by some 3—4 μm, suggesting that quite a considerable portion of the finer fibres are removed during processing. In addition, a portion of the short, fine component is also removed at the comb as noil. It was found the mean fibre diameter of the noil was from 1—4 μm finer than the raw hair. The grease content of the raw fibre was found to be roughly one-third that of merino wool, while the suint content, which was found to be almost twice that of merino wool, was also fairly alkaline. This was confirmed by observing an increase in the final pH of the first scouring bowl in spite of scouring under neutral conditions.

Willeying of the karakul had the result of removing a substantial portion of the vegetable matter. The willeying yields varied from about 90% for the most seedy lot to about 95% for the free to nearly free lots.

Card rejects increased with vegetable matter content while the combing tear was the lowest and percentage noil the highest for the shorter grades. By direct measurement of the wool base of the waste produced during scouring, carding and combing it was found that the present IWTO allowances for merino-type wools should not be used for predicting the actual fibre loss during the processing of karakul.

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THE USE OF PROPRIETARY NAMES

®Berol Lanco is manufactured by Messrs Berol Kemi and ®Bevaloid 4027 by Messrs Bevaloid S.A. (Pty) Ltd. The fact that these proprietary products have been used in this investigation in no way implies a recommendation from SAWTRI to the exclusion of other similar, or better, products.

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