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Sizing of Singles Ring and Rotor Yarns Comprising Wool/Cotton Blends

by

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SIZING OF SINGLES RING AND ROTOR YARNS COMPRISING WOOL/COTTON BLENDS

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ABSTRACT

Short staple wools were blended with cotton and spun into singles yarns on both the ring and rotor system. The yarn properties, size pick-up and weaving performance of these yarns were compared with each other and also with an all-wool worsted spun yarn and an all-cotton rotor spun yarn.

INTRODUCTION

An extensive amount of literature exists on rotor spinning, the properties of rotor spun yarns and of the fabrics subsequently produced from these yarns. In the present report no attempt will be made to review these works except in the fields of warping, sizing and the weaving of fabrics from rotor yarns, as these are considered relevant to the work described here. A review of rotor spinning has been carried out by Hunter[1].

Nick[2] carried out an extensive investigation on the weaving of rotor spun cotton yarns on a Sulzer weaving machine. He mentioned that with cotton yarns 0,6-1,5 warp end breaks per 1 000 ends/100 000 picks and 3 weft breaks/100 000 picks is about normal during weaving. He also found that the ends down rate was higher for rotor than ring yarns, although it was still acceptable. He also found that during sizing, rotor yarns had higher pick-ups of size than ring yarn and suggested that a reduction in size concentration could be possible for rotor yarns. In respect of fabric properties he found that rotor yarns produced fabrics which were harsher and had lower tensile strengths than the comparable ring fabrics, which is in line with many reports that rotor yarns are weaker than ring yarns. Also, he reported that rotor yarns are more hairy than ring yarns and give a fabric with more surface fibre, which improves cloth cover and gives a more uniform surface appearance, with possibly less need for weft mixing.

Gütersloh[3] reported that rotor yarns are livelier and snarl more during processing and that they should not be processed (viz: winding, warping, etc.) immediately after spinning but should be allowed to relax for between two and four days. He considered that rotor yarns feature fewer projecting hairs than ring yarns, and that hairiness of rotor yarns is at least 50% lower than that of ring yarns. Fibre abrasion and slubs are also lower for rotor yarns and knots in rotor yarn are some 10-15 times less than in ring yarns. For good weaving, elongation, evenness and abrasion resistance are more important than tensile strength and that the performance of correctly sized warps of rotor yarn is by no means inferior to that of warps from ring yarns. From sizing trials on rotor and ring-spun *cotton*[3], it was considered that the increase in tensile strength resulting from sizing, is relatively higher for rotor than for the ring. Elongation generally decreased due to size add-on. Another worker[4] agreed that rotor yarns use less sizing liquor, and states that fabric strength differences between rotor and ring is smaller than that found in the yarns.

In this report the investigations have been confined to the weaving of *wool/ cotton* blend yarns spun on both the ring and rotor systems and compared with a normal wool worsted yarn spun on the ring system and a normal cotton yarn spun on the rotor system.

EXPERIMENTAL

It was decided that the investigation should be conducted using the standard yarn linear densities, namely, 44, 37 and 27 tex as used in previous investigations[5,6] and that comparisons be made of the production and physical properties of these rotor yarns as compared with the previous wool/cotton blends[6] spun on the ring system.

Fibre

The fibres used in the various rotor blends were a 6/7 months Cape merino lambswool and a South African Deltapine cotton cultivar.

The fibre details are shown below.

Scoured Wool:–	mean fibre length	38 mm	CV 43,3%
	mean fibre diameter	19 μm	CV 23,0%
	Grease content		0,37%
Cotton – Deltapine Cultivar			
	Maturity ratio		0,83
	Fineness		179 millitex
	2,5% Span length		26,9 mm
	Micronaire		4,6
	Uniformity ratio		4,6
	Tenacity (3,2 mm gauge)		21,5 (cN/tex)
	Extension (%)		8,1

The all-wool control used throughout was of mean fibre length 54 mm and mean fibre diameter 21 μm as reported previously[5,6] and was processed on the worsted system. The ring blend yarns were spun from short wools as described in Technical Report No. 413[6].

Rotor Yarn Production:

Scouring

The 6/7 months greasy lambswool was scoured to a grease content of 0,37% (in two separate batches), well blended and sprayed with 0,3% ® Oxitex 40 (o.m.f.) and 4% water and allowed to condition before processing.

TABLE I

YARN PHYSICAL PROPERTIES AFTER SPINNING

Fabric blend (%)	Yarn linear density (tex)	Yarn twist (turns/m)	Breaking Strength (cN)	Tenacity (cN/tex)	Extension (%)	Irregularity (CV %)	Thin places/ 1 000 m	Thick places/ 1 000 m	Neps/ 1 000 m
All wool	44	560	306	7,0	23,9	15,3	4	12	8
(ring)	37	630	241	6,5	24,4	16,5	19	23	14
(control)	27	733	170	6,3	19,7	18,2	80	52	16
60/40 wool/	44	560	384	8,7	6,9	14,8	3	22	42
cotton	37	630	345	9,3	7,4	15,4	4	7	43
(ring)	27	733	233	8,6	6,6	15,8	18	9	48
60/40 wool/	44	725	235	5,3	8,2	14,3	10	7	128
cotton	37	785	179	4,8	8,9	13,9	5	7	161
(rotor)	27	1185	123	4,6	7,1	17,3	39	60	245
40/60 wool/	44	560	493	11,2	7,8	14,0	17	12	56
cotton	37	630	427	11,5	8,1	14,4	1	12	85
(ring)	27	733	305	11,3	7,4	15,3	6	9	60
40/60 wool	44	725	314	7,1	7,9	13,8	4	6	83
cotton	37	785	251	6,8	8,5	14,6	11	7	106
(rotor)	27	1185	173	6,4	7,0	15,9	16	29	303
All cotton	44	725	502	11,4	8,6	14,0	0	0	136
(rotor)	37	785	398	10,8	9,5	14,0	4	3	174
	27	925	282	10,4	8,8	14,6	6	8	211

Spinning

The scoured wool and cotton were blended in the ratios 60/40 and 40/60. These two lots as well as an all-cotton control lot were passed through a blowroom utilising three cleaning points, namely a porcupine opener, a double bladed beater and a Kirschner beater.

The laps from the blowroom were carded on a cotton card to a sliver density of 4,5 ktex. The card sliver was doubled 6 times and given two drawframe passages to produce a drawframe sliver of 4,5 ktex. This sliver was then fed directly to a Rieter MO5 rotor spinning machine (rotor speed 45 000 r/min) and three yarn linear densities produced: 44, 37 and 27 tex. A tex twist factor of 47,85 was used giving 725, 785 and 920 turns/m for the 44, 37 and 27 yarns respectively, but in the case of the 27 tex *blend* yarns the twist factor had to be increased to 61,25 (1 185 turns/m) to assure good spinning performance.

Ring Yarn Production

The production of these yarns is described in a previous report[6] where a short wool (mean fibre length of 35,5 mm and mean fibre diameter of 20 μm) was used and blended with cotton in the same blend ratios (60/40 and 40/60). The ring yarns were spun using a tex twist factor of 38,30.

Preparation

The yarns were wound and cleared on a Schlafhorst IKN cone winder fitted with Uster electronic automatic yarn clearers and Classimat recorder. The yarns were tested for breaking strength, extension, irregularity and thick and thin places and the results are shown in Table I. Warping was carried out on a Hergeth sample warping machine and two warps were made from each yarn lot of each yarn linear density. The warps were transferred onto the swift of a Hergeth sample sizing machine and sized using a 10% mix of ®Bevaloid 4032 (a blend of polyvinyl alcohols and modified starch plus auxiliaries). This size was chosen because of satisfactory results obtained in previous studies[5,6] and also because in this report comparisons will be made between the new results and those of certain previous results reported earlier.

TABLE II

SPECIFICATION OF FABRICS

Yarn linear density (tex)	44	37	27
Total ends	3 752	4 740	6 162
Ends x picks (grey)	22,04 x 23,23	28,23 x 28,34	36,22 x 29,13
Approx. finished mass (g/m^2)	240 – 260	220 – 240	200 – 220

Weaving

The specifications of the three basic constructions are given in Table II.

One warp from each yarn lot was woven on a conventional 190 cm Saurer 100W loom running at 165 picks/min and the other on a 2,16 m (85″) Sulzer VSK weaving machine running at 280 picks/min.

All the fabrics were woven under ambient conditions of 20°C and 70% RH. From each yarn lot samples of warp yarns before and after sizing were taken for add-on, breaking strength, extension and abrasion resistance tests. All warp breaks were recorded for each warp and weavability was assessed according to Table III as used previously[6].

TABLE III

ASSESSING WEAVABILITY FROM WARP BREAKS PER 1 000 ENDS/100 000 PICKS WOVEN

Warp breaks per 1 000 ends/ 100 000 picks	Assessment of weavability
nil	Excellent
0-2,49	Very good
2,5-4,99	Good
5,0-7,49	Fair
7,5-10,00	Poor
10,00 +	Very poor

Physical Properties of Yarns

The physical properties of the yarns and the measurement of size pick-up, etc., was carried out as described in an earlier report[5] and the results are shown in Tables I and IV, respectively.

TABLE IV

PROPERTIES OF WARP YARN BEFORE AND AFTER SIZING

Fabric Blend (%)	Yarn Linear Density (tex)	Actual Size Add-on** (%)	Goodbrand Single Thread Breaking Strength (cN)	Tenacity cN/tex	Extension at break (%)	Abrasion Resistance (Cycles to break)	End Breaks/1 000 Ends/100 000 Picks	
							Saurer	Sulzer
All-wool* (ring)	44	Unsized	304	6,9	18,6	76	–	–
		8,1	292	6,6	21,0	55	1,5	1,6
	37	Unsized	202	5,5	17,5	44	–	–
		6,3	279	7,5	16,8	39	1,3	30,8
	27	Unsized	156	5,8	9,3	54	–	–
		9,9	183	6,8	13,1	42	9,5	15,2
60/40 wool/ cotton (ring)	44	Unsized	348	7,9	6,8	53	–	–
		7,7	420	9,5	4,6	107	0	0
	37	Unsized	304	8,2	6,4	45	–	–
		7,8	366	9,9	5,4	58	0,8	0
	27	Unsized	224	8,3	7,5	51	–	–
		8,8	290	10,7	5,4	50	0	0,5
60/40 wool/ cotton (rotor)	44	Unsized	218	5,0	10,3	83	–	–
		11,7	282	6,4	3,9	157	0	0
	37	Unsized	178	4,8	5,9	53	–	–
		7,9	204	5,5	3,6	89	3,6	0,9
	27	Unsized	124	4,6	4,6	34	–	–
		10,5	130	4,8	3,2	139	16,9	54,9
40/60 wool/ cotton (ring)	44	Unsized	344	7,8	7,1	50	–	–
		8,8	552	12,5	6,3	156	1,0	1,0
	37	Unsized	384	10,4	6,6	44	–	–
		6,4	467	12,6	7,4	88	1,0	0
	27	Unsized	252	9,3	5,2	39	–	–
		9,3	385	14,3	5,1	68	0	0
40/60 wool/ cotton (rotor)	44	Unsized	314	7,1	7,7	97	–	–
		11,7	400	9,1	4,7	305	0,2	0
	37	Unsized	236	6,4	7,3	64	–	–
		8,7	282	7,6	4,2	106	1,1	1,1
	27	Unsized	162	6,0	5,8	36	–	–
		7,4	178	6,6	4,6	62	2,0	5,8
all cotton (rotor)	44	Unsized	418	9,5	10,7	87	–	–
		10,2	530	12,0	6,4	> 500	0	0,9
	37	Unsized	366	9,9	8,5	61	–	–
		8,1	468	12,6	6,8	353	0,6	0
	27	Unsized	230	8,5	6,9	47	–	–
		7,6	282	10,4	5,4	71	0,7	0,2

* Previously processed on the worsted system

** Actual size add-on corrected for residual foreign matter

– not determined

RESULTS AND DISCUSSION

YARN PROPERTIES

Tenacity

From Fig 1 it can be seen that as expected, the all-wool ring yarn although spun from a longer fibre, was not as strong as either the 60/40 or 40/60 wool/cotton blend yarns, and that the increasing cotton content gave increased tenacities. In the case of rotor yarns a similar trend was observed but at much lower tenacities, with a general reduction of about 40% in tensile strength when compared with ring yarns. The all-cotton rotor yarn was only as strong as a 40/60 wool/cotton blend ring yarn.

Extension

Fig 2 shows the relative extension at break values for these yarns. The all-wool ring yarns had, by far, the highest extension, but there was very little difference between the ring and rotor blend yarns, and the all-cotton yarn was only marginally better than the blends.

Yarn Irregularity

The all-wool control ring yarns had marginally the highest irregularity and the all-cotton rotor yarn the lowest, but as far as the blends were concerned, they were very similar.

Neps

It can be seen from Fig 3 that rotor yarns contained far more neps than the ring yarns and that the number of neps generally increased with increasing cotton content and decreasing yarn linear density.

EFFECT OF YARN PREPARATION ON THE TENSILE PROPERTIES

Tenacity

Fig 4 shows that, generally, there was a slight decrease in tenacity with a reduction in yarn linear density. Also, it can be seen that the general picture for each yarn linear density is similar. The yarn appeared to have lost some of its strength during winding and warping but after sizing the strength was increased and in many cases was higher than the original breaking strength.

Extension

It can be seen from Fig 5 that the extension of the wool yarn (control) dropped significantly as the yarn linear density was reduced, but with wool there appeared to be a tendency for the yarn to increase its extension during the sizing operation. The addition of cotton, however, resulted in a continuous deterioration in extension during processing, with the sized yarns having significantly lower extension than unsized yarns.

Effect of Size Add-on

From Fig 6 it can be seen that when a standard 10% size mix was applied to the various yarns, all-wool tended to have low pick-ups and relatively poor abrasion resistance. The abrasion resistance of the blend yarns improved with sizing in the case of high linear densities, but this was not the case for low linear densities. The abrasion resistance of the yarns increased with cotton content. Rotor yarns, generally, had higher size add-ons (about 1,5-2,0% more) than ring yarns, despite the higher twist factors used, with the cotton component apparently responding to size add-on to the best advantage. This was in agreement with the findings of other workers on other yarn types.

Weaving Performance

The number of end breakages/1 000 ends/100 000 picks gives an indication of the weaving performance of the various warps (Table IV). The all-cotton yarns performed the best. In turn the ring yarns performed better than the rotor yarns and as expected, the higher the yarn linear density, the higher the weaving performance.

It can be seen from the above results that although the size used in this investigation gave satisfactory weaving performance, especially on the blends and all-cotton, further investigations are required to find a better size for wool than the one presently used.

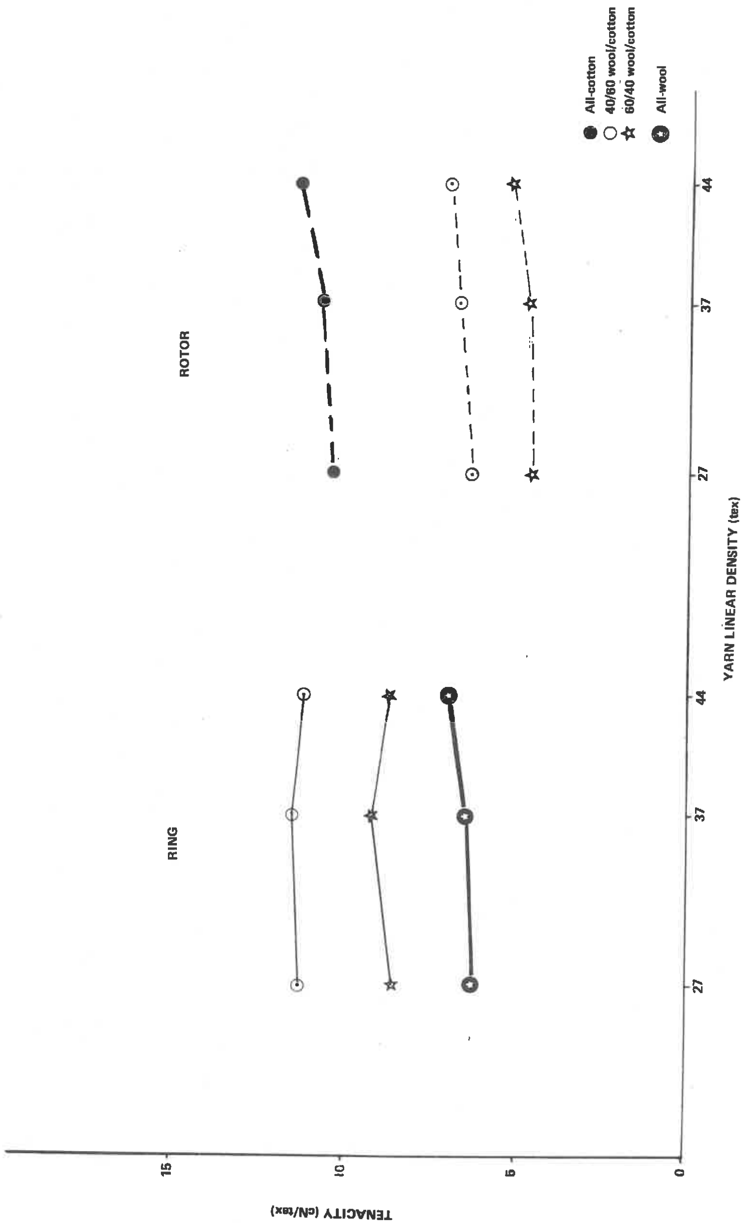

FIGURE 1
A Comparison of the Tenacity of Ring and Rotor Yarns. (Wool/Cotton Blends)

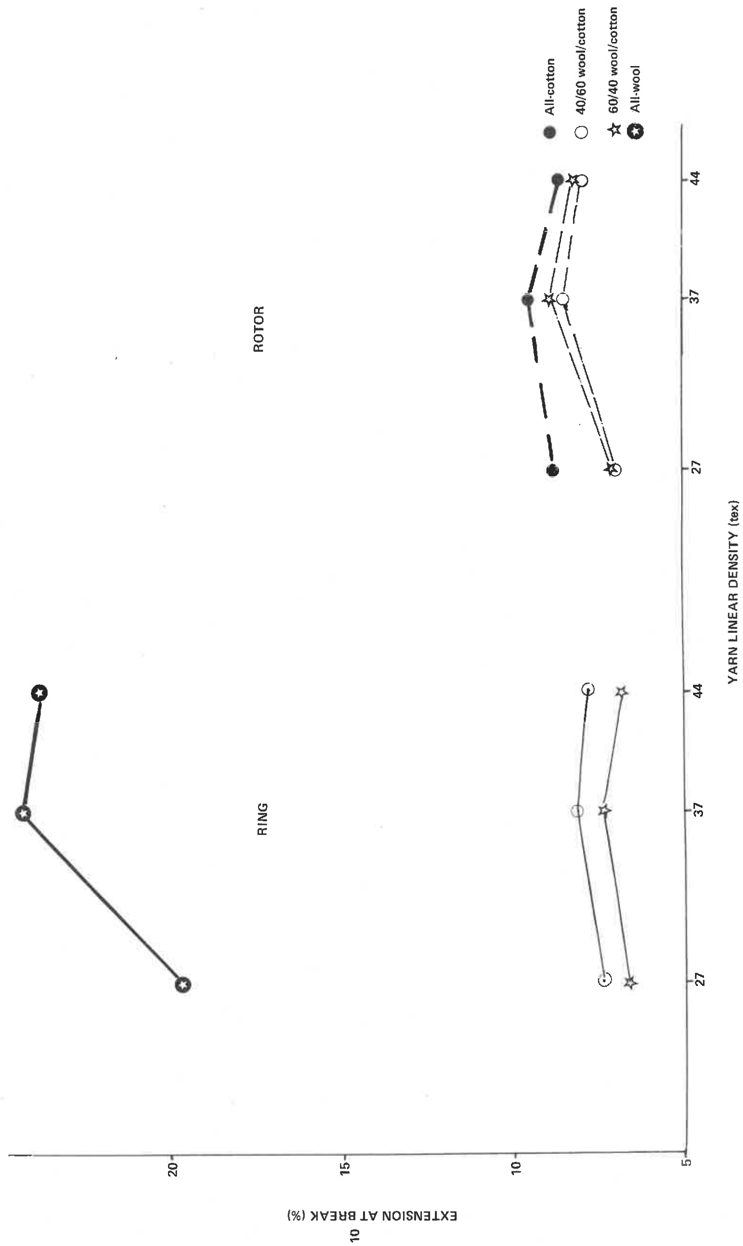

FIGURE 2

A Comparison of Extension of Ring and Rotor Yarns. (Wool/Cotton Blends)

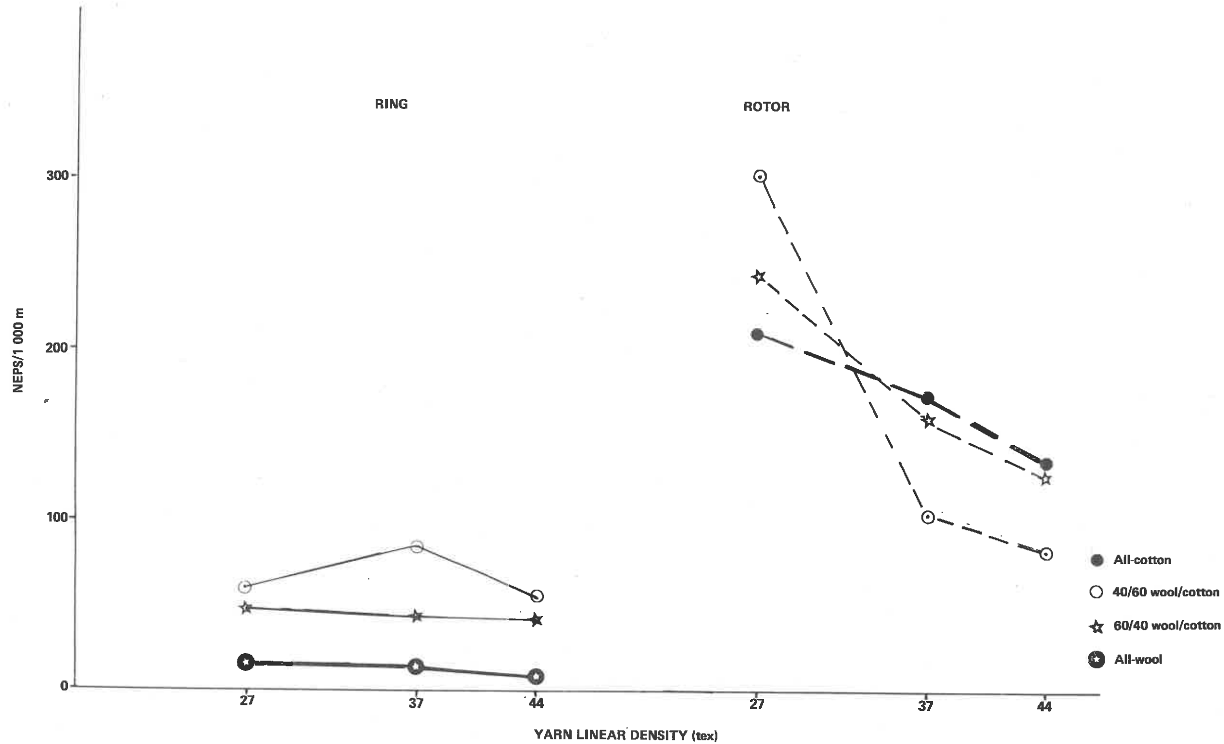

FIGURE 3

A Comparison of Neps in Ring and Rotor Yarns. (Wool/Cotton Blends)

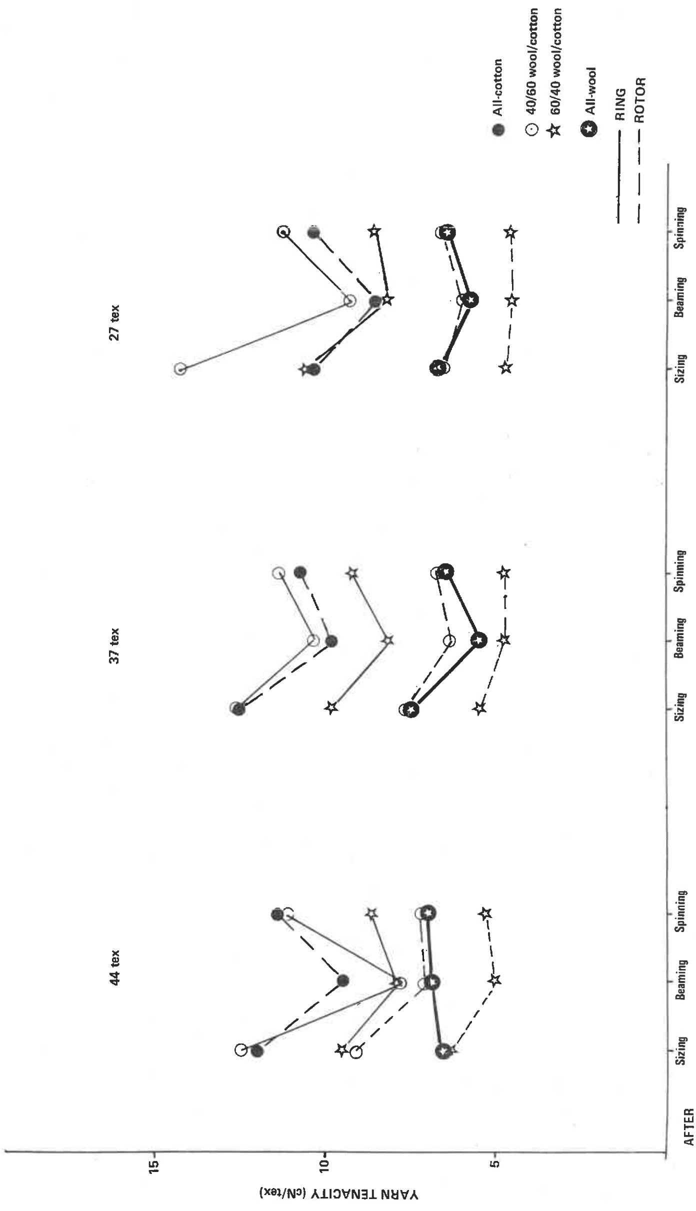

FIGURE 4
The Effect of Yarn Preparation on the Tenacity of Ring and Rotor Yarns.
(Wool/Cotton Blends)

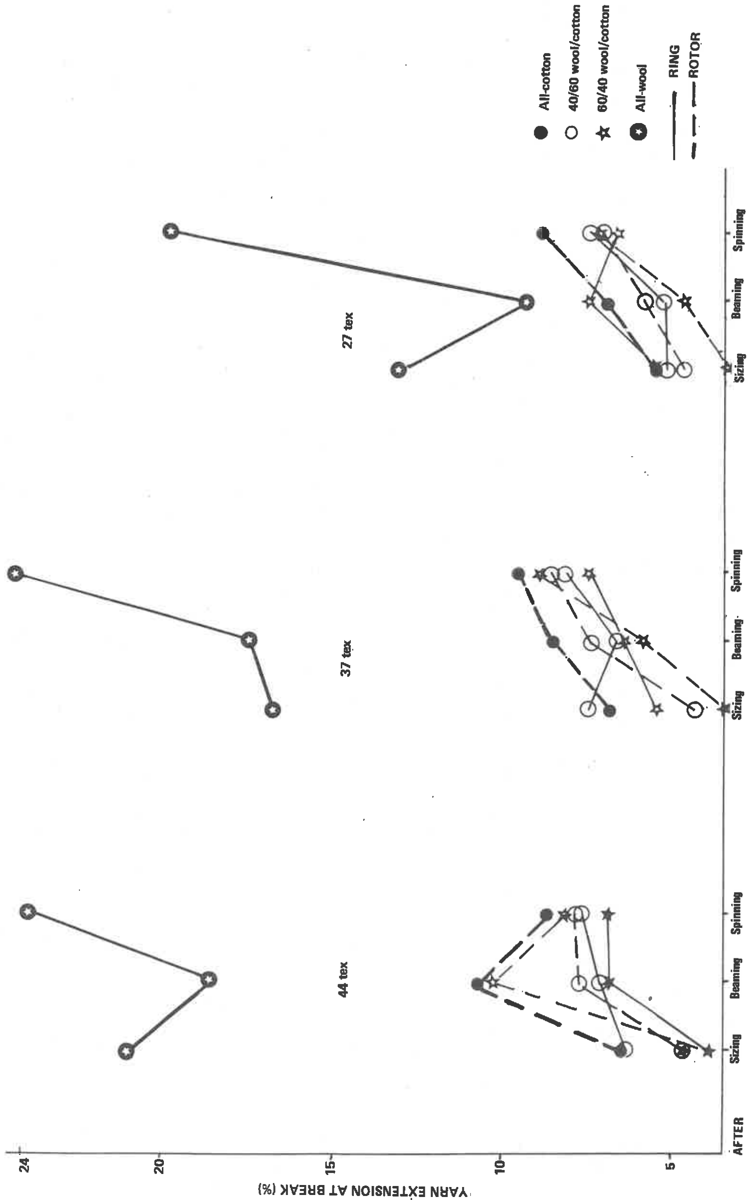

FIGURE 5

The Effect of Yarn Preparation on Extension of Ring and Rotor Yarns. (Wool/Cotton Blends)

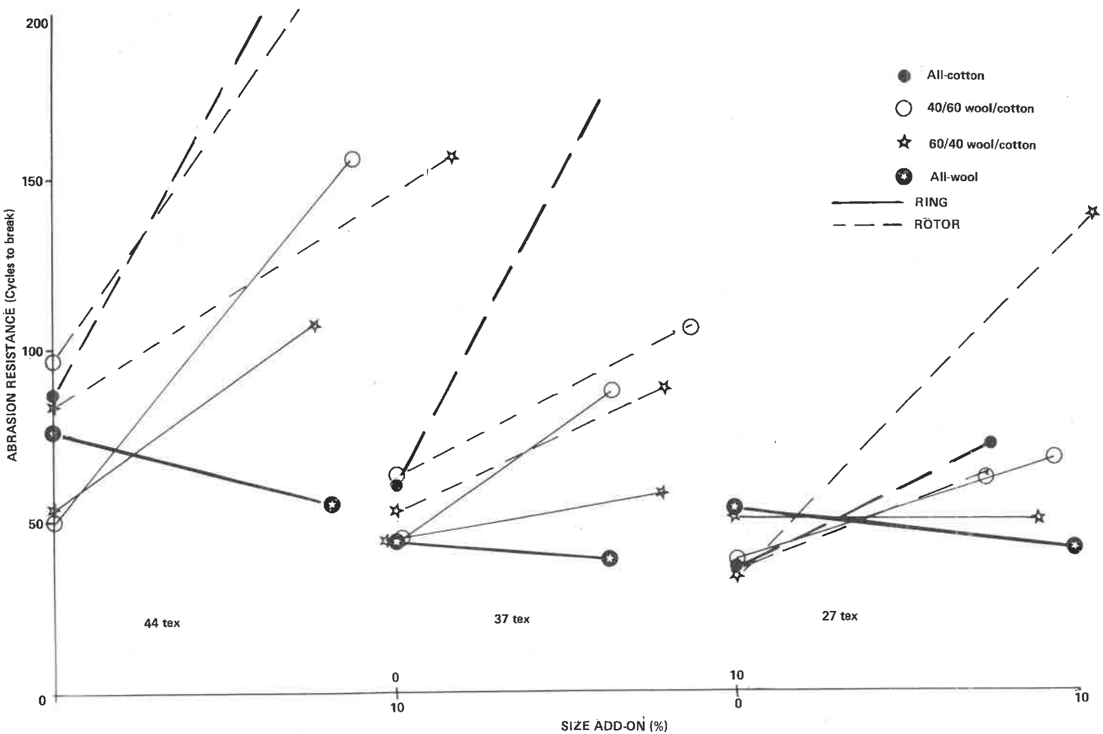

FIGURE 6

The Effect of Percentage Size Add-on on the Abrasion Resistance of Various Ring and Rotor Yarns

SUMMARY AND CONCLUSIONS

The preparation and spinning of both ring and rotor yarns have been described with special reference to wool/cotton blends, the wool fibre being of the short variety and the cotton having a 2,5% span length of 27 mm. Blends of 60/40 and 40/60 were produced and spun on the ring and rotor systems into three yarn linear densities, viz. 44, 37 and 27 tex singles yarns. All-wool *worsted* ring yarns spun from a 54 mm wool and all-cotton *rotor* yarns were also produced for comparison.

All the yarns were sized with a standard 10% mix of textile size (Bevaloid 4032) and weaving trials carried out on both conventional and projectile weaving machines and an assessment of warp weavability has been reported. All the yarn physical properties both before and after sizing were recorded and comparisons made between the various blends and types of yarns.

Although the all-wool yarn had the lowest strength of all the ring-spun yarns, it had the highest extension at break. Increasing cotton content in the blends produced stronger yarns but these blend yarns had lower extensions. It would appear that the rotor yarns had a slightly higher extension at break than the ring yarns and in fact, the all-cotton rotor yarn had a higher extension at break than any of the blend yarns. The rotor blend yarns had a significantly lower breaking strength than the ring yarns.

The yarns lost some strength during preparation, but after sizing yarn strength improved and was, in many cases, higher than the original values. There was a slight decrease in tenacity with a decrease in yarn linear density.

The number of neps in the yarn increased with increasing cotton content and also indicated that rotor yarns contained more neps than ring yarns.

Rotor yarns generally had higher size pick-ups than the ring yarns and the abrasion resistance of the sized yarns was significantly higher for the rotor than for the ring yarns. The cotton and cotton rich blends benefited most from sizing, again the poor results obtained on the wool component indicated that further investigation is still required.

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THE USE OF PROPRIETARY NAMES

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