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ROTOR-SPINNING OF COTTON DIRECTLY FROM CARD SLIVER

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ABSTRACT

In this report the authors comment on rotor-spinning directly from card sliver and on the beneficial effect on yarn properties of one drawframe passage prior to spinning. With a relatively low trash content in the card sliver the amount of trash collected in the rotors was insignificant. On the other hand, with a very trashy cotton, the tandem card removed more trash than a single card and, consequently, in the latter case the amount of trash removed by the automatic trash removal mechanisms on the rotor machines was also significantly higher. In this case the ends down in spinning also increased.

INTRODUCTION

Rotor-spinning, as compared with ring-spinning, normally requires only two drawing passages. Furthermore, the spinning speed is at least three times that of ring-spinning. If some further advances could be made by spinning directly from the card sliver, especially with coarse counts, great economic advantages would accrue.

It is generally claimed that deposits of micro-dust and trash in the rotor groove form one of the major problems in efficient rotor-spinning. It should be obvious that by spinning direct from card sliver special precautions have to be taken at a relatively *early stage* to ensure a relatively dust-free card sliver. Cognizance should, however, be taken of the great advances which have taken place in *automatic trash removal* by the trash boxes on rotor-spinning machines. In the light of these developments the need for obtaining such a dust-free sliver has, therefore, become less important. Nevertheless, continued attempts are being made to clean the cotton lint at a very early stage of processing.

Warlick[1] refers to several machines for removal of trash and micro-dust, e.g. the Saco Lowell Superior Cleaner, the Whitin Axiflow, the Rieter mono-cylinder, the Truetzschler plant and the Crosrol-Varga tandem card. In the case of the latter equipment it is claimed[2] that a Lancashire mill (Joshua Hoyle & Co) spins 84 tex (7's cotton) denim yarns on a system comprising a blowroom, five chute-fed Crosrol-Varga tandem cards, followed by three SACM rotor-spinners. Short-term irregularity on the card sliver is controlled by the Crosrol-Varga *STAL short-term autoleveller.* The cards are run at 36,4 kg/hr and the rotor diameters are 60 mm .

Naarding[3] gives some evidence on the nature of the rotor-deposits, both in respect of size and character. He also makes some suggestions as regards removing these impurities. He claims, for example, that substantial improvements can be brought about at a stage as early as *ginning.* The Daiwa Spinning Co. also conducted extensive trials[4] on the problem of dust removal in open-end spinning, while Kirschner[5] studied the effect of the carding method on deposit formation in OE-

spinning. He compared the BD-200, *without* a device for dirt separation with the Schubert & Salzer RU-11 equipped with a device for dirt separation and was able to demonstrate the special demands from the BD-200 in terms of cleanliness of the cotton sliver.

Thomson[6] stresses that relatively short fibres (e.g. 24 mm) can be spun directly from card sliver but with the longer fibres (e.g. 31 mm) it is virtually impossible to spin directly from card sliver and at least one drawframe passage will be required.

Tama[7] also concludes that short-staple material can be spun directly from the card sliver using short-cycle levelling. If medium counts are to be spun from relatively long fibres one drawframe passage would suffice. For fine counts a *second* drawing proved to be essential.

The effect of autolevelling of card sliver on yarn properties is dealt with by Messrs Uster[8].

In the present paper an attempt is made to enhance existing knowledge of the efficiency of trash removal on the card, and the effect of residual trash on rotor-spinning performance.

EXPERIMENTAL

For this investigation a Rhodesian Albar 72B (designated as "good cotton" for the purpose of this study) and a Brazilian cotton (designated as "trashy cotton") were used (see Table I for fibre details). The cotton was processed through the blowroom line consisting of a porcupine opener, a two-bladed and a Kirschner beater and formed into laps. For the Brazilian cotton an *additional cleaning point,* i.e. the ERM cleaner, was incorporated.

The laps were then subjected to the following carding procedures:

(i) Carding on a single cotton card (revolving flats) *without* and *with* a Graff Optima Autoleveller (manufactured by Messrs Graff, Switzerland). (The latter controls *short-term irregularities* in the outgoing sliver.) The rate of production was maintained at 7,5 kg/hr.

(ii) Carding on a Crosrol-Varga tandem card equipped with an *LTAL autoleveller* (which can only control long-term irregularities). The rate of production was maintained at 25 kg/hr.

After carding of the good cotton, half of the slivers from each procedure was subjected to one drawframe passage at a delivery speed of 120 m/min.

Rotor-spinning of the good cotton was carried out on a Schubert & Salzer Model RU-11 equipped with 55 mm rotors and *cotton opening rollers.* Rotor speed was maintained at 40 000 r/min and the opening roller speed at 7 000 r/min. Spinning of a 50 tex yarn with a tex twist factor of 48 (cotton twist factor of 5,0) was carried out for 8 hours (i.e. 30 000 metres of yarn were produced).

For the trashy cotton a Rieter MO/5 machine was used. The rotor diameter was 55 mm and the speed 45 000 r/min. The opening roller speed was 7 000 r/min.

The main reason for using the Rieter machine is that the amount of trash removed by the automatic trash removal mechanism could be conveniently determined.

Testing

Slivers were tested for uniformity on the Uster irregularity tester. The rotor yarns obtained were tested for hank strength, single yarn tenacity, irregularity, number of thin and thick places and neps per 1 000 m and hairiness.

RESULTS AND DISCUSSION

As can be seen from Table I the trash contents of the two samples of cotton differed significantly.

Good cotton

The irregularity values obtained for the carded slivers (see Table II) showed that the most uniform sliver was produced by the *single card* equipped with a *Graff autoleveller* (Lot C). When this particular sliver was subjected to one drawframe passage (Lot D), irregularity increased slightly. This can possibly be attributed to the introduction of drafting waves into the original card sliver.

The most irregular card sliver was produced on the Crosrol tandem card (Lot E) probably because this card was only equipped with a *long-term autoleveller.* One drawframe passage (Lot F) reduced the irregularity but uniformity was still worse than that of the single card (Lot A) or single card plus one drawframe passage (Lots A and B).

Results obtained for single yarn tenacity (see Table III) showed that yarn tenacity was *increased* by one drawframe passage – all the tenacity values for yarns from carding only were found to be lower than those of the same lot that

TABLE I

FIBRE CHARACTERISTICS OF COTTONS USED

Property	Albar 72B	Brazilian cotton
2,5% Span Length (mm)	27,23	28,3
50% Span Length (mm)	13,03	12,5
Uniformity ratio	48	44
Maturity ratio	0,88	0,82
Fineness (mtex)	167	182
Micronaire	3,95	4,0
3,2 mm Gauge tenacity (cN/tex)	23,3	17,8
Bundle extension (%)	7,0	6,8
Trash (%)	2,80	5,8

were also subjected to one drawframe passage. The CSP values did not show any significant difference between the different carding methods or between the card only and carding plus one drawframe passage except for the single card only (Lot A) where the CSP value was low when compared with the other lots.

The neppiness of the yarns also decreased when the card sliver was subjected to one drawframe passage. The values obtained for Lots B, D and F (lots which had one drawframe passage) were lower than those obtained for the carded only lots (Lots A, C and E). Yarn regularity remained almost constant for all lots.

As the level of impurities in the rotors was always less than 20 mg/kg of yarn, these impurities were simply ignored.

Trashy cotton

The results in Table IV show that the tandem card was more effective in the removal of trash.

Table V shows the details of the yarns spun from the two carded slivers. There is little to choose between the resultant yarn properties but the amount of trash removed from the trash boxes was significantly different with that from the single card being the highest. Also, the number of end breaks was markedly higher with the single card sliver (208 as against 95 per 1 000 rotor-hours).

TABLE II

DETAILS OF PROCESSING ROUTES*

Lot No.	Carding Method	Sliver Irregularity (CV %)
A	Normal single card	3,4
B	Normal single card + one drawframe passage	3,6
C	Normal single card plus Graff autoleveller	1,8
D	Normal single card + Graff autoleveller plus one drawframe passage	3,0
E	Crosrol tandem card with LTAL autoleveller	6,4
F	Crosrol tandem card with autoleveller plus one drawframe passage	4,3

*For Brazilian cotton only lots equivalent to C and E above were processed. The CV (%) for sliver irregularities was 2,25 and 5,25 respectively.

TABLE III

PHYSICAL PROPERTIES OF 50 TEX YARN SPUN FROM GOOD COTTON

Processing Procedure	Total Number of metres spun	Yarn Tenacity (cN/tex)	Extension (%)	CSP	Thin Places per 1 000 m	Thick Places per 1 000 m	Neps per 1 000 m	Yarn Irregularity (CV %)
Single Card	2 500	11,1	10,7	1609	0	2	41	13,2
	10 000	10,8	10,5	1686	0	1	57	12,7
	20 000	11,4	10,8	1520	0	0	69	14,1
	30 000	10,6	10,6	1652	1	2	212	13,0
	Average	10,8	10,7	1617	0	1	95	13,3
A + one drawframe	10 000	11,8	10,5	1928	1	5	47	13,6
	20 000	12,0	10,3	2058	0	3	64	13,3
	30 000	11,9	10,7	2021	0	9	62	13,4
	Average	11,9	10,5	2002	0	6	58	13,4
A + Graff Autoleveller	2 500	10,5	10,2	1961	0	6	65	13,3
	10 000	10,6	9,9	2062	0	0	78	13,0
	20 000	11,1	10,1	2053	0	6	154	13,5
	30 000	10,3	9,7	2129	1	6	83	13,4
	Average	10,6	9,9	2051	0	5	95	13,3
C + one drawframe	2 500	11,7	10,3	2035	0	17	51	14,6
	10 000	12,2	10,6	1979	1	4	90	13,7
	20 000	12,2	10,3	1978	2	10	59	13,5
	30 000	12,3	10,3	2016	0	6	89	13,6
	Average	12,1	10,4	2002	1	9	72	13,9
Crosrol Card	2 500	10,5	9,9	1997	3	2	33	13,8
	10 000	11,2	10,1	1982	0	3	43	14,2
	20 000	11,0	10,1	1991	1	2	25	14,2
	30 000	10,7	9,8	2052	1	3	29	13,3
	Average	10,9	10,0	2006	1	3	33	13,9
E + one drawframe	2 500	11,8	11,0	1916	1	4	19	13,5
	10 000	12,2	10,7	1908	0	3	26	13,1
	20 000	12,1	10,6	1951	1	4	10	12,9
	30 000	11,5	10,8	1879	1	3	26	13,1
	Average	11,9	10,8	1914	1	4	20	13,2

NOTE: A smooth doffing tube navel and metallic wire opening rollers were used.

TABLE IV

DETAILS OF TRASH REMOVAL* AND WASTE PRODUCED DURING PROCESSING OF BRAZILIAN COTTON

Stage	%Trash	% Waste	
		Single card	Tandem
Raw cotton	5,80	4,51	5,10
Lap	4,08		
Single card	1,01		
Tandem	0,60		

*As obtained by Shirley Analyser

SUMMARY

A relatively good cotton having a trash content of 2,8% and a rather trashy cotton (5,8% trash) were processed into carded sliver. The carding operation was performed either on a single card with a short-term autoleveller or a tandem card using a long-term autoleveller, or a single card with no autoleveller. For the good cotton, half of the carded slivers produced from each trial was subjected to *one* drawframe passage and the other half was used directly for spinning. The good cotton was spun into 50 tex yarns on the Schubert & Salzer RU-11 at a rotor speed of 40 000 r/min, an opening roller speed of 7 000 r/min and using a rotor diameter of 55 mm.

The yarn results from the good cotton showed that an *additional drawframe passage* had a beneficial effect on yarn properties. Furthermore, an autoleveller removing *short-term* irregularities from the card sliver was preferable to one removing *long-term* irregularities. The amount of trash (or microdust) collected from the rotors was negligibly small.

For the *trashy cotton* half of the laps was passed through a tandem card and the other through a single card with a Graff autoleveller. Spinning was performed directly from card sliver on the Rieter MO/5 rotor spinner. The tandem card was found to remove more trash than the single card and the card sliver from the single card gave a higher trash removal on the rotor box as well as a higher number of ends down during spinning.

TABLE V

DETAILS OF 50 TEX YARNS FROM BRAZILIAN COTTON SPUN ON RIETER MO/5

Processing route	Mass of yarn spun in kg	Trash removed by automatic trash remover in g	End breaks per 1 000 rotor hrs	Yarn tenacity (cN/tex)	% Extn.	CSP	% Irregularity	Thick places/ 1000 m	Thin places/ 1000 m	Neps/ 1000 m	Hairiness (hairs/ metre)
Single card with Graff autoleveller	36	78,3	208	10,5	10,5	1670	13,5	0	6	160	4,9
Tandem card with LTAL autoleveller	39,3	23,8	85	10,1	10,5	1790	13,6	1	2	47	5,7

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