EFFECT OF BLOW ROOM SETTINGS ON SLIVER QUALITY

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ABSTRACT

In this paper a brief survey of the effect of the main opening line machineries (parameters) - and their interaction on the properties of the produced carded sliver prepared to be processed on rotor spinning, has been investigated. Trials were made for the evaluation of the optimum condition, for the preparation of the cotton sliver for rotor spinning system. The recommended settings of the blowing room machineries to obtain the best carded sliver preparation to be fed to open-end spinning machines, have been given.

INTRODUCTION

Very intensive efforts are made to develop and establish the rotor spinning system. Although many goals have already been reached, some technology and material related problems remain not to be solved. One of these is trash (foreign bodies, neps, dust ... etc) contained in cotton. The trash content of cotton depends on its type and processing [7]. Type of ginning napping, material purity and subsequent processing affect in certain specific ways. A preliminary conclusion was that, open-end spinning needs opening room cleaning that will not break fibres and that carding should be relied on to remove broken fibers in strips and fly waste [12]. It has been stated by Artzt [3] that for the raw cotton with cleaning efficiency was between 40 % - 60 % depending on the contamination of the fibers and the place of the origin of fibre bales.

Soliman & El-Messiery [9] recommended that in case of spinning cotton wastes on open-end spinning machine there is no need for using draw frame, but an autoleveller device on the carding machine must be used. They has shown that, for Ashmony cotton waste it could spin OE Yarn count 16's.

Schenek [10] has concluded that, the cotton raw material contains contaminations of vegetable and mineral origin which can not be completely eliminated in the processing stages preceding rotor groove during rotor spinning which called "rotor deposits"

Grafton [5] has stated that the process of yarn formation in rotor spinning becomes less precisely controlled due to the trash particles accumulation in the yarn forming groove.

Hunter [6] has stated that the amount of trash in the rotor groove may have an adverse effect on the yarn spinning tension inside the rotor.

Chewning [2] has stated that the accumulation of dust and trash in rotor groove cause a deterioration of yarn properties. The effective fiber preparation to the required standard require a pre-determined level of sliver regularity and parallelistion of fibers in the sliver [3].

Soliman and El-Messiery [9] recommended that when carding cotton wastes, the taker in speed and flats speed, must be increased.

From an intensive experimental work, it was found that the parameters of the blow-room machineries have appreciable effects on the quality of the carded sliver [11].

The object of this work is to investigate the blowing room settings which have the significant effect on the quality of the carded sliver to be processed on open-end spinning machine, specially for a low grade blend of fibres, made of different blend of fibers, made of different waste.

EXPERIMENTAL WORK

The effect of each machine parameter in the Trutzschler opening line on the quality of the produced slivers has been studied. Each machine parameter (setting) was changed according to a factorial design. The trash content, the neps per gram, ... etc were measured for each change in the machinery's parameter. For illustrating our study, the bale opener GBR has been chosen as an example where the same technique has been used for the other opening line's machineries.

The determination of the trash content % in the carded sliver has been carried out by using the selector apparatus [13]. The fibre damage % has been measured by using both of the comb Sortet & the Fibrograph apparatuses.

The neps per gram has been carried out by a special technique. Also, the sliver evenness has been measured by the uster evenness tester model (I). The used cotton was Giza 75 with grade (G -1/4) 60% 20&% Noils + 10% flat strips + 10% under casing waste.

The three main investigated parameters of the bale opener *GBR were:*

(1) Setting of the grid bar angle under both the stripper and precleaner roller (A).
(2) Setting between spiked lattice and evenner roller (B)
(3) Spliked attice speed (c).

Table 1 shows the combination treatment and the bale opener's GBR Settings.

Exp. No.	Treatment Comb.	Settings		
		A	B(mm)	C(r.p.m)
1	I	(2)	5	5.5
2	a	(4)	5	5.5
3	b	(2)	20	5.5
4	ab	(4)	20	5.5
5	c	(2)	5	7.5
6	ac	(4)	5	7.5
7	bc	(2)	5	7.5
8	abc	(4)	20	7.5

First of all the different parameters which determine the carded sliver quality were measured along the line and are given in Tables (2 and 3) which indicat that each machine has a speperate effect on eeach parameter depending on the fed raw meterial quality as well as the setting of each machine. In order to get the best conditions, the combinations of the designed experiment was run and a low grade cotton mix was chosen.

RESULTS AND DISUSSION

Table (2) gives the results obtained from the analysis of the cotton during processing *100% GIZA 70 grade* (G+1/4)' using Trutzcher blowing-room line.

The results show that, the mean tuft weight in (gm.) of the bale cotton has been reduced from 644.5 gm. to 101.5 gm. during the processing of cotton through the blow-room line, which directly reflected on the cotton density which reduced form 0.0350 gm/cm^3 to 0.0054 gm/cm^3 for the cotton processed by Kirschner beater, R.K.

It is also clear that the degree of opening increased from 28. 57 cm/gm^3 to 185.19 cm/gm^3.

The analysis shows that although the opening and separating effect of the individual stages is different, all of them increase the number of neps per form (60-190) neps/gm.

Also the trash content % was reduced form 3.1% to 2.1 % and the total cleaning efficiency % of the blowing-room line in this case has been found 32.26%, porcupine beater, R.N., give the high cleaning efficiency % than the other machineriees.

The percentage of fiber damage reaches its high value at bale opener, GBR, and porcupine beater, RN, due to the intensive opening.

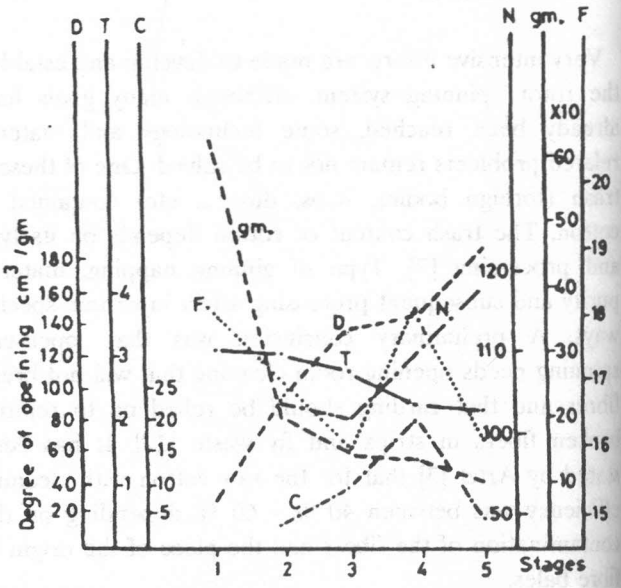

Figure 1. Complete analysis of B.R.L. for processing high grade cotton.

Figure (1) represents the complete analysis of the blow-room machineries for the long staple GIZA 70 cotton.

The sliver produced after carding has the following properties:

Sliver count = 0,25 Nm.
Sliver size = 4 gm./mt.
C.V. % evenness = 5.1%
Neps/ gm. = 240
Fibre damage % = *18.9%*
Trash content % = 0.94%

The results indicates that the carding machine inceases slightly the neps/gm (190-240), while trash content % is nearly fifty precentage removed but there is a slight increase in the percentage of the fibre damage.

Another analysis of the properties of the low grade cotton mix)70% GIZA 75 cotton grade (G -1/4 + 30%

The neps per gram has been carried out by a special technique. Also, the sliver evenness has been measured by the uster evenness tester model (I). The used cotton was Giza 75 with grade (G -1/4) 60% 20&% Noils + 10% flat strips + 10% under casing waste.

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The analysis shows that although the opening and separating effect of the individual stages is different, all of them increase the number of neps per form (60-190) neps/gm.

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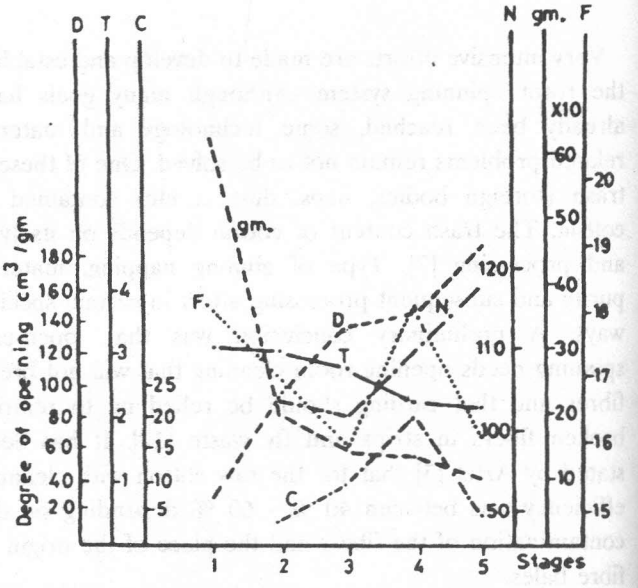
The percentage of fiber damage reaches its high value at bale opener, GBR, and porcupine beater, RN, due to the intensive opening.



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The results indicates that the carding machine inceases slightly the neps/gm (190-240), while trash content % is nearly fifty precentage removed but there is a slight increase in the percentage of the fibre damage.

Another analysis of the properties of the low grade cotton mix [70% GIZA 75 cotton grade (G -1/4 + 30%

cotton wasre) was done. The results of the Trutzschler blowing-room line in this case is given in table (3).

From the obtained results, the mean tuft weight in (gm.) of the cotton mix has been reduced from (190.97) gm. to 61.0 gm. during the processing of the cotton mix. through the blow-room line, these results reflected directly on the cotton density and the degree of opening, which reduced the cotton density from (0.01904) g,/cm^3 to (0.0061) gm/cm^3. And it is also clear that the degree of opening increased from 52.63 cm^3/gm for cotton mix. to 163.9 cm^3/gm after Kirschner beater. The analysis shows that the number of neps/gm increases from (135 to 260) neps/gm through the blow-room stages. Also the trash content % reduced from (3.68% to 2.2%), while the total cleaning efficiency % of this blow-room line has been found (50.22%), porcupine beater, RN, and Axiflo opener, AFA, gives the high values of the cleaning efficiency respectively, than the other machines.

The fibre damage % reacshes its high value at bale opener (17.79%) and cleaner, R.Z. with saw tooth cylinnder due to intensive opening. Figure (2) shows the complete analysis of the blow-room machineries for the processed low grade cotton mix.

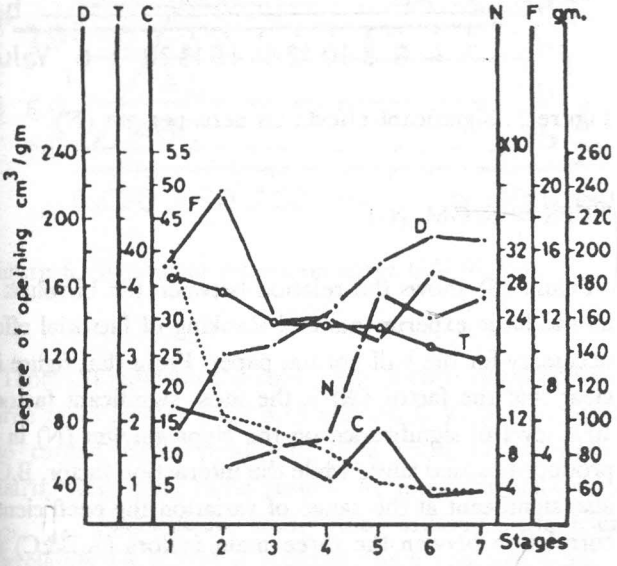

Figure 2. Complete analysis of the blow-room line for processing low grade cotton mix.

The produced carded sliver have the following properties:

Sliver count	= 0.20 Nm
Sliver size	= 5 gm./mt.
C.V.% evenness	= 5.92%
neps/gm	= 540
Fibre damge%	= 19.3%
Trash content%	= 0.82%

These results are higher than that obtained for the processing pure 100% Gize 70 cotton due to the difference in the cotton properties, although there is an increase in the no. of cleaning points as well as the seperate opening of the cotton wastes before mixing.

It is recommended that the trash content% in the fed sliver to open-end spinning machine should not more than 0.15% while the neps per sqare inch should be (16-30) the C.V.% evenness should be 4.5 for carded sliver count (0.20 Nm).

Comparing the obtained results for the carded sliver of pure cotton and mixed cotton, it is clear that it is necessary to do some basic experiments in the blow-room line of processing low grade to confirm the recommended carded sliver properties feed to the open-end spinning machine.

Table (4) represents the bi-values for all the carded sliver measurements of the bale opener basic experiments (4). The coefficient of correlation between the three main factors and each measured property of the carded sliver has been calculated in a from of correlation matrix. At the same time the multiple coefficent of correlation (R) has been determined for each case as given table (5)

N.B.

The measured carded sliver properties.

where:

1. Trash content T%
2. Fiber damage F%
3. Neps per gram N
4. Sliver evennes E

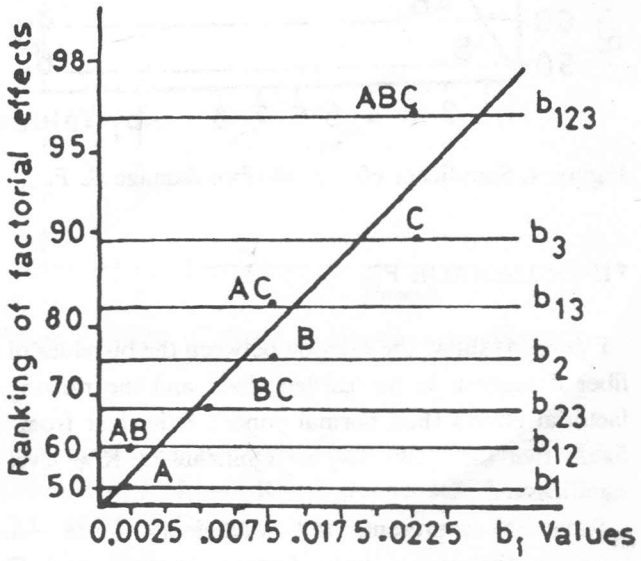

Figure 3. Significant effects on trash content % T.

TRASH CONTENT

Figure (3) shows the relation between the ranking of factorial effects and the bi-values (half normal paper) of carded sliver's trash content. From the figure it can be shown that the most significant on the trash% are factors B&C respectively while the coefficient of correlation between the three main factors (A,B&C) and the carded sliver's trash content %, is given in the form of a correlation matrix as given in table (5). The highest values of coefficient of correlation are r_{14} & r_{15} and this agree with the previous results of the (half normal paper). The multiple coefficient of correlation (R=0.693) is significant at 0.02 level of significance.

Thus the carded sliver cleanliness is influenced by the effect of spicked lattic settings and speed.

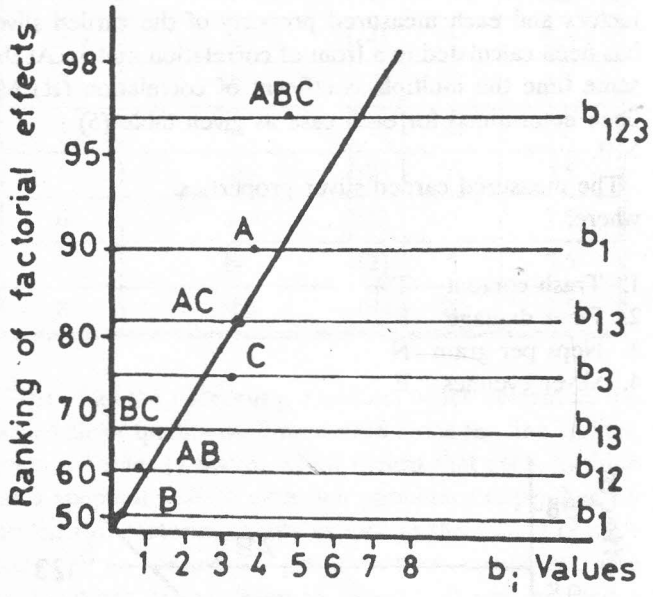

Figure 4. Significant effects on fibre damage % F.

FIBER DAMAGE F%

Figure (4) shows the relation between the bi-values of all fiber damage% in the carded sliver and the ranking of factorial effects (half normal paper). It is clear from the figure that the factor (A) is significant at 10% level of significance.

Table (5) represents the coefficient of correlation between the three main factors (A,B,C) and fibre damage% for the carded sliver prodiced in a from of correlation matrix. These results shows that the highest r_{12} & r_{14} respectively, while the multiple coefficient of correlation R = 0.634 is significant at 0.01 level of significance.

Thus the carded sliver's fibre damage is highly influenced by the grid angle setting position (A) of bale opener

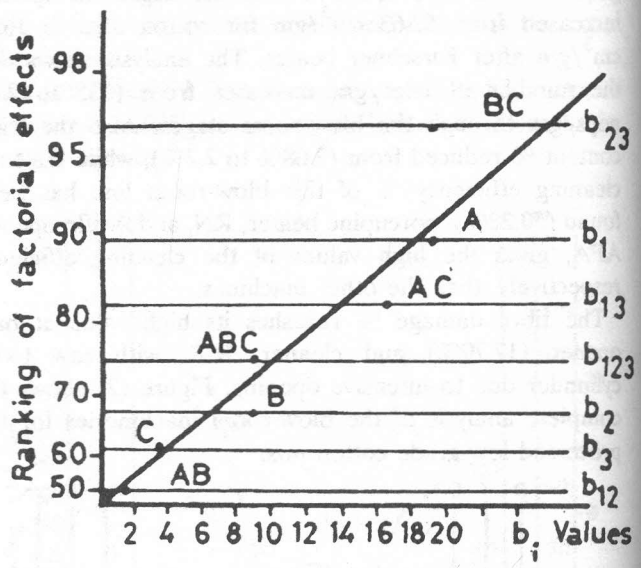

Figure 5. Significant effects on neos per gm (N).

NEPS PER GM. (N)

Figure (5) shows the relation between the bi-values for all the basic experiments and Ranking of factorial effects necessary for the half normal paper. From that figure it is clear that the factor (A) is the most significant factor at 10% level of significance on the Neps gm/gm (N) in the produced carded sliver while the interaction factor, B.C. is also significant at the range of variation the coefficient of correlation betwen the three main factors (A,B&C) and the carded sliver produced is indicated in a form of correlation matrix as shown in table (5). The obtained results seems to be highly influenced by the effect of factor (A) and interaction factor, B.C. respectively.

The multiple coefficient of correlation (R = 0.756) is high and significant at 0.01 level of significance, consequently the obtained results confirm the previous results of the cooton neps/gm processed by bale opener, beside the carding machine parameters effect.

USTER EVENNESS (E)

Figure (6) shows the relation between the bi-values of the carded sliver C.V. % evenness (E) and the ranking of factorial effects (half normal paper). From this figure it was noticed that the most significant factor is the setting of the grid bars angle under the stripper and the precleaner roller factor (A_1) of the bale opener under investigation of 5% level of significance.

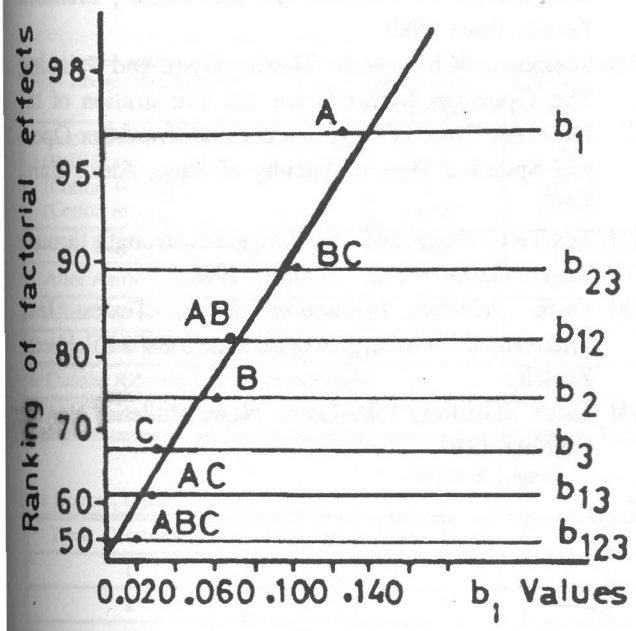

Figure 6. Significant effects on sliver C.V.% Eve.

Table (5) indicates the coefficient of correlation between three main factors (A,B &c) and the C.V. % evennes of the carded sliver produced, in a form of correlation matrix. Regarding these results the most correlation are r_{12}, r_{14} respectively while the multiple coefficient correlation (R 0.759) is relatively high and significant at 0.01 level of significance and these obtained results Justify the prevous results, in other word the carded sliver C.V. % evenness is highly in fluenced by the Trash contet% but it is well known that the carding machine included chute-feed system and uster card control device has a great effect on the produced carded sliver C.V. evenness. (E).

By using the same technique for the other openning line's machines such as stepcleaner 5R6 cleaner RN ... etc, similar results and discussions can be obtained (6-9).

In the following tables (6-9), the correlation materices of the different machineries will be shown.

CLEANING EFFICIENCY

Figure (7) shows the effect of the differnt stages of the blow room including the carding stage on the cleaning efficiency. The cleanning efficiency of any stage in the blow room has been choosen according to the optimum settings of the machinery (stage). It is clear frrom the figure that the residual trash content decreases, which reflects on the open-end spinning process as yarn quality and ends down.

N.B.

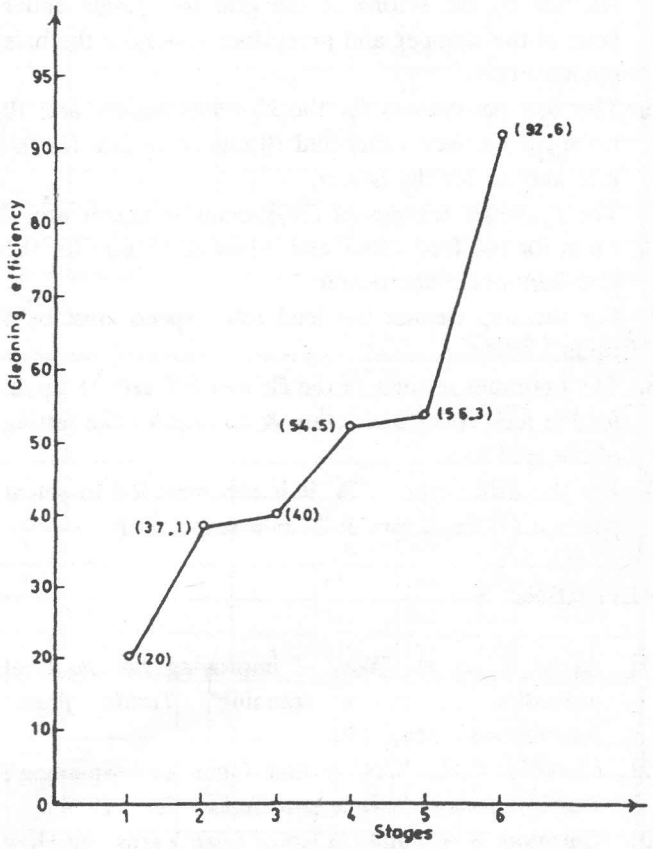

Figure 7. Effect of stages on the cleaning efficiency.

The mentioned previous stages are; 1. cleaner RZ, 2. Axiflo AFA, 3. cleaner RN, 4. cleaner RK, 5. step cleaner SRS6 and 5 carding machine.

CONCLUSIONS

From the previous results and discussion, the following conclusions can be drawn out.

1. The most significant effects of the bale opener GBR parameters on trash content % of the carded sliver are the spiked lattice-evenner roller setting and the speed of the spicked lattice.
2. The grid bars angle setting of the bale opener GBR affects significantly the fibre damage in the carded sliver.
3. The Neps per gm of the carded sliver is influenced directly by the setting of the angle of the grid bars of the bale opener GBR.
4. The results evenness of the carded sliver is greatly affected by the setting of the grid bars angle under both of the stripper and precleaner rollers of the bale opener GBR.
5. The best parameters for the kirschner beater are; 10 r.p.m for the feed roller and 10 mm & 16 mm for the grid bars under the beater.
6. The optimum settings of the procupine beater are; 7 r.p.m for the feed roller and 9 mm & 15 mm for the grid bars under the beater.
7. For the step cleaner the feed roller speed must be 4 r.p.m.
8. The optimum settings of the cleaner RZ are; 11 r.p.m. for the feed roller and 9 mm & 15 mm for the setting of the grid bars
9. For the axiflo type AFA, it is recommeded to set at position (3) i.e. 6 mm & 20 mm respectively.

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Table 2.

Blow Room Machineries	Mean tuft weight gm	Cotton density	Degree of opwening	Neps/grm N	Fibre Damage % F	Trash content % T	Cleaning efficiency % C
1. Before Bale opener (Bale Cotton)	644.5	0.0350	28.57	60	18.10	3.1	-
2. After Bale opener	204.0	0.0110	90.90	120	17.10	3.0	3.23
3. After step cleaner beaters	137.8	0.0074	134.14	110	16.03	2.7	10.0
4. After porcupine beater	132.0	0.0070	142.85	150	18.2	2.2	18.5
5. After Kirschner beater	101.5	0.0054	185.19	190	16.2	2.1	4.55

Table 3.

Blow-Room Machineries	Mean tuft weight gm	Cotton density	Degree of opening	Neps/grm N	Fibre Damage % F	Trash content % T	Cleaning efficiency % C
1. Before Bale Opener							
(Bale Cotton)	253.8	0.0252	39.68	120	14.9	3.8	-
(Cotton Waste)	122	0.0121	82.64	170	15.7	3.4	-
(Cotton mix)	190.97	0.0190	52.63	135	15.14	3.68	-
2. After Bale opener	100.9	0.01004	99.6	118	17.79	3.4	7.61
3. After Axiflo opener	97.9	0.0097	103.1	90	11.8	3.0	11.8
4. After Step cleaner beaters	83.4	0.0082	121.95	100	12	2.8	6.66
5. After Porcupine beater	67.3	0.0066	151.515	270	10.7	2.4	14.28
6. Cleaner RZ with saw tooth cylinder	60	0.0059	169.49	240	15.3	2.3	4.17
7. After Kirschner beater	61	0.0061	163.9	260	13.5	2.2	4.347

Table 4. Experimental results of 2^3 factorial experiments

Bale Opener, GBR — Carded Sliver Prope

Treat. Combination	Exp No.	Total	A'	B'	AB	C'	AC	BC	ABC	"T"	"F"	"N"	"E"
I	1	+	-	-	+	-	+	+	-	0.12	11	380	4.31
a	2	+	+	-	-	-	-	+	+	0.06	18.1	290	4.68
b	3	+	-	+	-	-	+	-	+	0.04	22.1	340	4.39
ab	4	+	+	+	+	-	-	-	-	0.06	13.1	290	4.41
c	5	+	-	-	+	+	-	-	+	0.08	36.5	300	4.14
ac	6	+	+	-	-	+	+	-	-	0.17	10.6	310	4.54
bc	7	+	-	+	-	+	-	+	-	0.12	23.2	370	4.58
abc	8	+	+	+	+	+	+	+	+	0.10	19.8	350	4.79

Total "T"	+0.38 -0.36	0.23 0.42	0.36 0.38	0.46 0.28	0.42 0.32	0.40 0.34	0.28 0.46
Mean	0.0025	-0.0125	-0.0025	+0.0225	0.0125	0.0075	0.025
Total "F"	+61.6 -92.8	78.2 76.2	80.4 74.0	90.1 64.3	63.5 90.9	72.1 82.3	96.5 57.9
Mean	- 3.9	0.25	0.80	3.23	-3.425	-1.275	4.82
Total "N"	+1240 -1390	1350 1280	1320 1310	1330 1300	1380 1250	1390 1240	1280 1350
Mean	-18.75	8.75	1.25	3.75	16.25	18.75	-8.75
Total "E"	+18.42 -17.42	18.17 17.67	17.65 18.19	18.05 17.79	18.03 17.81	18.30 17.48	18.0 17.84
Mean	0.125	0.063	-0.0675	0.0325	0.00275	0.11	0.02
(bi) values	b_1	b_i	b_{12}	b_3	b_{13}	b_{23}	b_{23}

(A) Grid Bars angle setting (B) Spicked lattice evenner roller setting (C) Spicked lattice speed
(T) Trash content % (F) Fibre damage % (N) Neps/gm (E) C.V % evenness

Table 5. Correlation Matrix

Bale Opener, GBR — Carded Sliver Prop

	Trash Content T				Fibre Damage %				Neps/gram				C.V. % evenness			
	Y	A	B	C	Y	A	B	C	Y	A	B	C	Y	A	B	C
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Y/1	1	0.066	-0.334	0.602	1	0.406	0.031	0.491	1	-0.556	0.259	0.335	1	0.596	0.187	0.430
A/2		1	0	0		1	0	0		1	0	0		1	0	0
B/3			1	0			1	0			1	0			1	0
C/4				1				1				1				1
	Multiple Coefficient of Correlation R = 0.692				R = 0.638				R = 0.756				R = 0.759			

Table 6. Correlation Matrix

Feeding unit, B.E. and step cleaner, SRS6 — Carded Sliver Prop

	Trash Content T				Fibre Damage %				Neps/gram				C.V. % evenness			
	Y	A	B	C	Y	A	B	C	Y	A	B	C	Y	A	B	C
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Y/1	1	-0.0906	0.5804	0.2732	1	-0.099	-0.473	-0.330	1	-0.093	-0.373	-0.0935	1	0.188	0.404	-0.188
A/2		1	0	0		1	0	0		1	0	0		1	0	0
B/3			1	0			1	0			1	0			1	0
C/4				1				1				1				1
	Multiple Coefficient of Correlation R = 0.645				R = 0.585				R = 0.395				R = 0.484			

Table 7. Correlation Matrix

Porcupine Beater R.N. — Carded Sliver Prop

	Trash Content T			Fibre Damage %			Neps/gram			C.V. % evenness		
	Y	A	B	Y	A	B	Y	A	Y	Y	A	B
	1	2	3	1	2	3	1	2	4	1	2	3
Y/1	1	-0.558	-0.613	1	-0.906	-0.759	1	0.314	-0.943	1	0.019	-0.857
A/2		1	0		1	0		1	0		1	0
B/3			1			1			0			1
C/4									1			
	Multiple Coefficient of Correlation R = 0.829			R = 0.972			R = 0.994			R = 0.857		

Table 8. Correlation Matrix

Cleaner RZ with Saw tooth cylinder — Carded Sliver Prope

	Trash Content T			Fibre Damage %			Neps/gram			C.V. % evenness		
	Y	A	B	Y	A	B	Y	A	B	Y	A	B
	1	2	3	1	2	3	1	2	4	1	2	3
Y/1	1	-0.948	-0.316	1	0.446	0.181	1	-0.372	-0.407	1	0.880	-0.428
A/2		1	0		1	0		1	0		1	0
B/3						1			1			1
C/4												
	Multiple Coefficient of Correlation R = 1			R = 0.481			R = 0.552			R = 0.979		

Table 9. Correlation Matrix

Kirschner Beater, R.K. — Carded Sliver Prope

	Trash Content T			Fibre Damage %			Neps/gram			C.V. % evenness		
	Y	A	B	Y	A	B	Y	A	B	Y	A	B
	1	2	3	1	2	3	1	2	4	1	2	3
Y/1	1	0.447	-0.894	1	-0.476	0.547	1	-0.745	0.596	1	-0.420	-0.823
A/2		1	0		1	0		1	0		1	0
B/3						1			1			1
C/4												
	Multiple Coefficient of Correlation R = 1			R = 0.725			R = 0.954			R = 0.857		