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STUDY OF CARDING MACHINE WITH ENHANCED TRANSFER COEFFICIENT

A PROJECT REPORT

Submitted by

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சாரம்சம்

நூல் நூற்புத்துறையில் உள்ள மிக முக்கியமான இயந்திரங்களுல் கார்டிங் இயந்திரமும் ஒன்று. பஞ்சினைத் தனித்தனியாக பிரித்தெடுப்பதில் இவ்வியந்திரம் முக்கிய பங்குவகிக்கின்றது. எந்த ஒரு முன்னேற்றம் இவ்வியந்திரத்தில் ஏற்படும், நூலின் தரத்தினை உயர்த்தும் என்பதில் ஐயமில்லை.

நடப்பில் இருக்கும் கார்டிங் இயந்திரத்தில் பஞ்சானது தனித்தனியாக பிரித்தெடுத்த பின்பும் சிலிண்டரிலிருந்து டாஃப்ரிற்கு ஒரே தடவைக்குள் இடம் பெயர்வதில்லை. பஞ்சானது 4லிருந்து 20தடவை வரை சிலிண்டரின் முட்களில் ஓட்டிக்கொண்டு மீண்டும் ஃப்ளாட்டிற்கு இடையே செல்கிறது. இதனால் பஞ்சானது தனது நீளத்தையும், வலிமையையும் இழக்கின்றது. மேலும் சில பஞ்சுகள் சுருண்டுகொள்கிறது. இதனால் நூலின் தரம் வெகுவாகக் குறைகிறது.

மேற்கூறிய பிரச்சனைகளைக் களைவதற்கு காற்றை உபயோகித்து அனைத்து பஞ்சுகளையும் கார்டிங் செயல் முடிந்தவுடன் ஒரே தடவைக்குள் உறிஞ்சிக்கொள்வதுதான் சிறந்த வழி. இதற்காக இந்தத் திட்டத்தில் காற்று உறிஞ்சுதல் மற்றும் அழுத்தக்காற்று, ஆகிய இருவேறு வழிமுறைகளைப் பின்பற்றி உரு வரைபடம் தீட்டப்பட்டு உருவாக்கப்பட்டுள்ளது.

உருவாக்கிய இயந்திரத்தினை கார்டிங் இயந்திரத்தில் பொருத்தி ஆராய்ந்ததில் அழுத்தக்காற்றைவிட காற்று உறிஞ்சுதலில் அதிக பஞ்சமாற்று ஏற்படுகிறது. வெளிவந்த பஞ்சினை ஆராய்ந்ததில் பஞ்சானது கொத்துக் கொத்தாக உள்ளது. இதனை உருவாக்கிய இயந்திரத்தினை மேம்படுத்துவதன் மூலம் சீர்படுத்தலாம்.

Carding is the very important process in spinning. Considering carded yarn, the carding machine is the final stage of opening the fibers. So any improvement in carding will certainly improve the quality of yarn.

In normal carding machine the disposition of wire points between the Cylinders to Doffer is being point to point, the transfer coefficient is very low between 0.1 to 0.4. This means that the fibers have to rework between 4 to 20 revolutions. It causes fiber rupture and sometimes to curl, if the wire points are not properly maintained at optimum condition. This results in disposition of fibers as layers at all the time on the cylinder surface thereby reducing the effectiveness of carding action towards fiber individualization. Further, the surface speed of doffer being lower than the cylinder, hook formation occurs at the time of transfer.

In this project an attempt has been made to transfer all the fiber from cylinder surface using pneumatic so as to improve the transfer factor near one and avoid hook formation. Towards that, two systems, one working on compressed air and another on pneumatic suction has been designed and fabricated and its performance was studied. It has been found that the fiber transfer is better in the case of suction system than that of the compressed air.

Occasionally fiber cluster are noticed on the delivery material, which calls for further investigation through changes in relative speeds of working elements.

CONTENTS

S.NO.	TITLE	PAGE NO.
	ABSTRACT	vii
	LIST OF TABLES	ix
	LIST OF FIGURES	x
	LIST OF SYMBOLS	xi
1.	INTRODUCTION	1
2.	LITERATURE SURVEY	3
	2.1 Carding	4
	2.2 Objects of carding	4
	2.3 Basic actions of carding	4
	2.4 Cylinder - flat action	7
	2.5 Concept of operational layer	11
	2.6 Estimation of operational layer	13
	2.7 Cylinder to doffer action	16
	2.8 Mechanism of fiber transfer and hook Formation	18
	2.9 Estimation of hooks	20
	2.10 Factors affecting transfer coefficient	22
3.	OBJECTIVE	25
4.	MEHODOLOGY	27
5.	DESIGN OF DEVELOPMENT CONCEPT	30
6.	RESULT AND DISCUSSION	38
7.	CONCLUSION	45
8.	LIST OF REFERENCES	47

LIST OF TABLES

TABLE NO	TITLE	PAGE NO
1.	Fiber hooks	9
2.	Cylinder load	12
3.	Cylinder speed and Q	14
4.	Sliver weight vs. cylinder speed	14
5.	Card sliver wt. And yarn quality	15
6.	Cylinder and doffer speed on fiber mass transfer	16
7.	Nepcount-Normal sliver	39
8.	Nepcount-design-1	39
9.	Nepcount-design-2	39
10.	Lap-Fiber length	40
11.	Lap-Fiber fineness	41
12.	Sliver-Fiber length	41
13.	Sliver-Hank	42
14.	Design-1 Fiber length	42
15.	Design-2 Fiber length	43

LIST OF FIGURES

FIGURE NO	TITLE	PAGE. NO
1.	Carding machine	5
2.	Carding action	5
3.	Stripping action	6
4.	Carding force vs. flat location	7
5.	Fiber orientation in carding	9
6.	Fiber transfer	10
7.	Operational layer concept	11
8.	Mechanism of fiber transfer	18
9.	Cylinder- doffer transfer of fibers	19
10.	Friction forces acting on a fiber	21
11.	Cylinder / doffer speeds vs. carding action	24
12.	Gearing diagram	29
13.	Components	34
14.	Design 1	35
15.	Design 2	37
16.	Neps/100 square of web	40
17.	Span length chart	43

LIST OF SYMBOLS

S.NO	SYMBOLS	ABBREVIATIONS
1.	T_H	Trailing hooks
2.	L_H	Leading hooks
3.	B_H	Both sided hooks
4.	Q	Cylinder load
5.	Q_o	Operational layer
6.	Q_2	Recycling layer
7.	Q_1	Fiber mass transferred from cylinder to doffer
8.	K	Transfer factor
9.	UR	Uniformity ratio

1. INTRODUCTION

In spinning process there are numerous factors which influence yarn quality such as fiber quality, process parameters and machinery conditions.

In revolving flat card, the doffer plays an important role in collecting the fibers from the cylinder. After completing the carding action the fibers are not directly transferred to doffer. Some of the fibers remains with the cylinder as recycling layer and turns as operating layer. The present carding machine works with the transfer coefficient of 0.1 to 0.4. It is observed that only 20% of the fibers on cylinder surface are picked-up by the doffer, while the rest go back to the cylinder and flat zone. Thus the fibers may even go up to 4 – 20 times around the cylinder surface before being transferred. This means that fiber gets repeatedly subjected to carding action, which might deteriorate the fiber quality.

Carding is the important process in spinning with respect to quality. Fiber individualization is the primary feature of a card. Considering production the operating layer and transfer factor is the limiting factor. In this project an attempt is made to enhance or increase the transfer coefficient, which is expected to improve the carding performance. However when transfer coefficient is improved, operational layer will reduced. This leads to less reworking of fibers and hence reduces nep formation.

2

2. LITERATURE SURVEY

2.1 CARDING [6]

Carding is the process of reducing tufts of entangled fibres into a filmy web of individual fibres by working the tufts between closely spaced surfaces clothed with opposing sharp points. Considering carded yarns, carding is the final stage to clean and individualize the cotton.

2.2 OBJECTS OF CARDING

As above mentioned the card opens the tuft of masses into individual fibres, simultaneously cotton gets cleaned. The main objects of carding are given below.

- To open the flocks into individual fibers,
- Cleaning or elimination of impurities and dust,
- Reduction of neps,
- Elimination of short fibers,
- Fiber blending,
- Fiber orientation.

2.3 BASIC ACTIONS OF CARDING [11]

2.3.1 CARDING ACTION: This is fiber separation process from the tuft of masses between two interacting surfaces. The important conditions are

- a) There should be two wire-covered surfaces facing each other, with distance of 0.3mm or less.
- b) The wires of both the interacting surfaces should be in such a way that the point or tip of wire from one surface should face the point or tip of wire from other clothed surface.
- c) The interacting surfaces should move either in same or opposite direction at the point of interaction.

4

2. LITERATURE SURVEY

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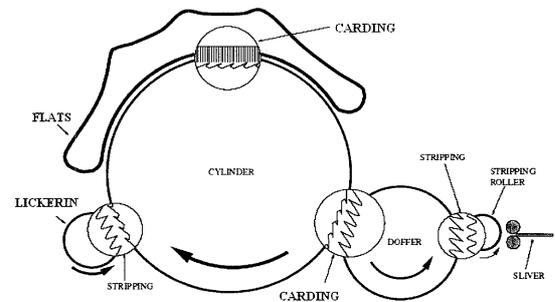


Fig 1. Carding Machines

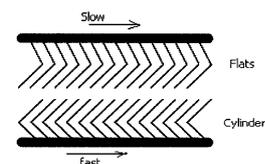
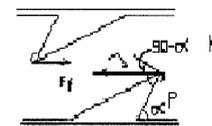


Fig 2. Carding Action

$$K = F_f \cdot \sin \alpha$$

$$P = F_f \cdot \cos \alpha$$

$$P > \mu K, \text{ for effective carding action.}$$

$$\text{So, } \cot \alpha > \mu$$

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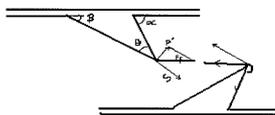
- F_f - Force acting on a fiber tuft being pulled by two wire points
- Tension can be resolved into K & P
- K - Perpendicular to front flank of wire point
- P - Acting along front flank of wire point

It is clear that as the coefficient of friction between the fiber and the wire point decreases, the forward angle of inclination of the wire point increases.

2.3.2 STRIPPING ACTION

This action is a fiber transfer process from one wire surface to other. The important conditions are

- There should be two wire covered surfaces facing each other with the distance of around 0.3mm or less.
- The wires of both interacting surfaces should be inclined in such a way that the point or tip of wire from one surface should face the back of wire from one surface should face the back of wire from the other closed surface.
- The interacting surfaces should move either in same or opposite direction at the point of interaction.



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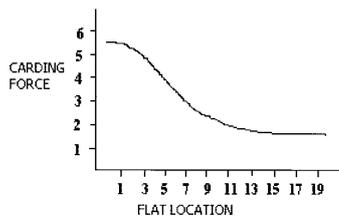


Fig 4. Carding Force Vs Flat Location

The closer cylinder – flats setting and faster cylinder speeds will give more effective carding and combing action and improve web quality through reduced neps and trash. Because of low mechanical stresses, smaller cylinder can be rotated at higher speeds than larger cylinder diameter. Higher teeth densities and lower cylinder speeds were as effective as lower as lower teeth densities and higher cylinder speeds.

Since the action of the cylinder in this region is to individualize fibers, the wire clothing has a steeper rake and a higher cylinder speeds greater forces may be involved and result in fiber breakage.

8

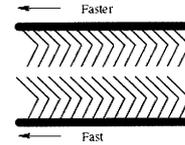


Fig 3. Stripping Action

$$P^1 = F_f \sin \beta$$

$$S = F_f \cos \beta$$

Stripping of fibres is possible only if

$$S > \mu P \text{ or}$$

$$\cot(\alpha - \theta) > \mu$$

Where θ is the angle subtended by the front and back flanks of the wire point, which is $(180 - \beta)$

2.4 CYLINDER - FLAT ACTION [6]

Before to carding zone, air is dragged along by rotating cylinder and at carding zone, the flow is suddenly restricted by the narrow gap. So air movement lifts the tuft lets towards the flat.

The flat movement in the direction of cylinder rotation, tend to load quickly with the tuft lets as they reach the interfere with the cylinder, acquiring two- thirds of their final load for each working cycle of carding action with the cylinder.

The carding action is the combination of two sub actions namely

- Shearing
- Combing.

The shear action occurs where the upper layer of a tuft let or a loosely opened fiber group is caught and held by flat. The top layer hangs from the flat and makes contact with subsequent teeth of cylinder clothing as they pass by this give rise to combing.

7

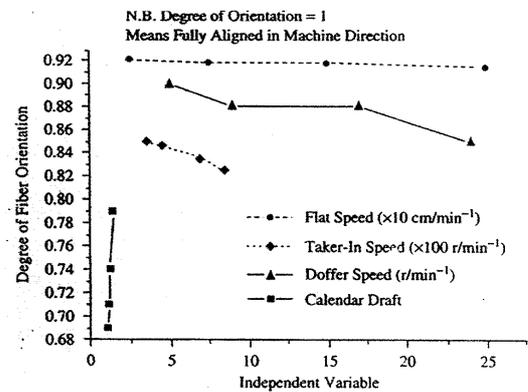


Fig 5. Fiber Orientation in Carding

Table 1. Fiber Hooks [6]

Location	T_H	L_H	B_H	No hooks	Others
Cylinder surface	61%	4.3%	4.3%	26.1%	4.3%
Doffer web	43.5%	19.6%	21.7%	10.7%	4.3%

$P_f = Q_{fc} / Q_0$, probability of fiber being carded between cylinder and flats during one cylinder revolution

Q_{fc} = fiber mass held between flats and cylinder in carding state

Q_0 = cylinder load

9

2.5 CONCEPT OF OPERATIONAL LAYER [6]

The above snapshots show that the fibers are not fully transferred from cylinder to doffer. Due to less transfer factor, the fiber may revolve 5 to 20 revolutions. This will cause fiber damage, Nep and hook formation. The fiber, which remains in the cylinder, is termed as recycling layer. These fibers lead to cylinder loading and affect the carding action. Thus operational layer should be minimized for effective carding, which ultimately leads to good fiber individualization.

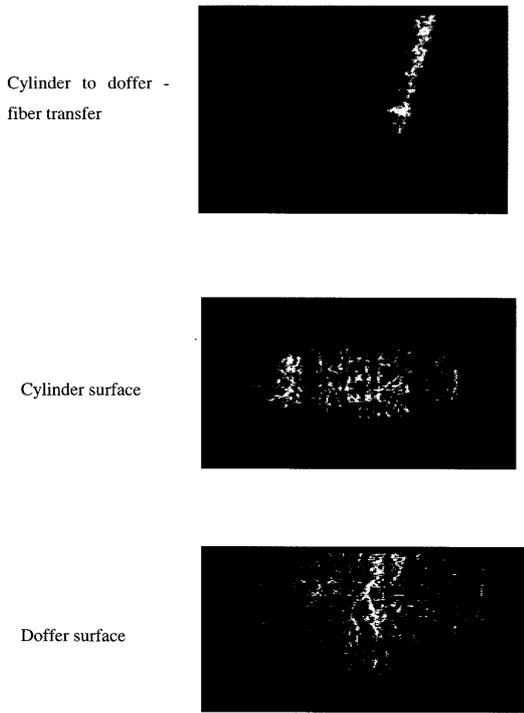
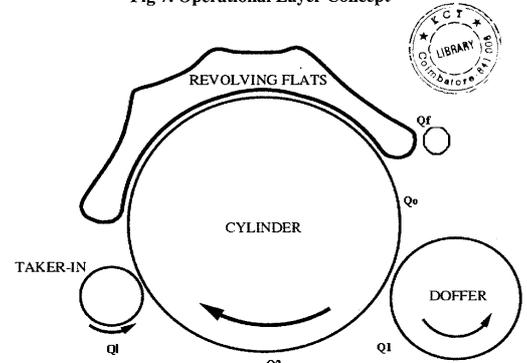


Fig 6. Fiber transfer- Snap shots taken just after the point of transfer between the Cylinders to the Doffer [6]

Fig 7. Operational Layer Concept



- Q1 – fiber mass transferred from cylinder to doffer
 - K - transfer factor
 - Q2 – Recycling layer
 - QL - fiber mass transferred from licker in to cylinder
 - Qf – Flat strips
 - Qo- Operational layer
- Where Q is mass per unit time

$$K = Q_1 / Q_0$$

$$Q_0 = Q_2 + Q_{lc} - Q_f$$

$$Q_{lc} + Q_2 = Q_f, \text{ Cylinder load}$$

Q_f = Fiber mass, Cylinder revolution contributing to flat surface. If

$$Q_0 = Q_1$$

$K = Q_1 / Q_0 = 1$, then transfer factor is 1.

$$Q_{lc} = Q_1 * V_t / V_c$$

V_t – Taker in surface speed

V_c - Cylinder surface speed

Hence, from the start of carding, the build up of cylinder load Q_0 , the doffer web Q_1 and recycling layer Q_2 will follow the geometric progression.

Table 2. Build Up Of Cylinder Load, Doffer Web And Recycling Layer

CYLINDER REV.	FIBER MASS FED TO CYLINDER	CYLINDER LOAD Q_0	FIBER MASS TRANSFERRED TO DOFFER Q_1	RECYCLING LAYER Q_2
1	Q_{lc}	Q_{lc}	$Q_{lc} * K$	$Q_{lc}(1-K)$
2	Q_{lc}	$Q_{lc} + Q_{lc}(1-K)$	$K(Q_{lc} + Q_{lc}(1-K))$	$(1-K)Q_{lc} + Q_{lc}(1-K)$
3	Q_{lc}	$Q_{lc} + (1+(1-K) + (1-K)^2)Q_{lc}$	$Q_{lc}(1+(1-K) + (1-K)^2)K$	$(1-K)Q_{lc} + (1+(1-K) + (1-K)^2)Q_{lc}(1-K)$
N, n-α		$\frac{Q_{lc}(1-(1-K)^n)}{K}$	$Q_{lc}(1-(1-K)^n)K$	$Q_{lc}(1-K)(1-(1-K)^n) \frac{1-K}{K}$
$(1-K)^n - 0$	Q_{lc}	$\frac{Q_{lc}}{K}$	$Q_{lc}K$	$\frac{Q_{lc}(1-K)}{K}$

2.6 ESTIMATION OF CYLINDER LOADING [4]

At a steady state condition the card accumulates some quantity of fibres. This does not include the fibers embedded into the clothing, which in any case compromise a very small quantity for metallic fillet. At any time the cylinder has a operating layer of fibers Q_0 from which a percentage K is transferred to the doffer during every rotation of the cylinder.

The amount Q_0 can be determined as follow. When the card attains a steady state condition the doffer is disengaged and feed and drive to the flats is also disengaged. The doffer is started again. At first, the fibers between the doffer comb and the junction of the cylinder and doffer come out and then the fibers from the cylinder are transferred to doffer.

There is a clear dividing line between the two. If the doffer is kept running for 3 - 4 minutes. It will ease to deliver any more fibers. The weight of fibers from the dividing line can be taken to be an appropriate estimate of Q_0 . it may be noted that unless the flats are disconnected and taken-off Q_0 as determined by this method may be affected to some extent by interchange of fibers from cylinder to flats.

$$Q_0 = \frac{200 \Pi R_c P}{3.6 K V_c} \text{ (grams)}$$

$$P = 3.6 V_d T$$

Where, R_c = Cylinder radius in mtr

V_c = cylinder surface speed (m/min)

V_d = doffer surface speed (m/min)

T = sliver hank (K tex)

P = production (Kg/hr)

Table 3. Cylinder Speed and Q

Production = 8 lbs / hr, sliver wt. = 49.1 gms / yd, doffer = 8.2 rpm

Cylinder speed (rpm)	Q (gms)	K%	Nep count Shirley method
180	102	4.92	116
215	85	4.92	126
260	60	5.76	116
315	49	5.82	98

Table 4. Effect of Sliver Weight and Increased Cylinder Speed,

P = 8 lbs / hr

Cylinder	Doffer	Sliver wt. (gms/yd)	Q(gms)	K%
315	11.8	34.3	51	5.62
260	9.8	41.5	58	6.02
215	8.2	49.1	85	4.92
180	6.8	60	100	4.64

P = 12 lbs / hr

Cylinder	Doffer	Sliver wt. (gms/yd)	Q(gms)	K%
315	17.7	34.3	50	8.61
260	14.6	41.5	58	7.54
215	12.4	49.1	105	6.02
180	10.1	60	130	5.78

14

Table 5. Card Sliver Wt. And Yarn Quality

Doffer speed	Sliver wt. (gm/ yd)	Neps / gm of sliver
11.8	34.3	13
8.2	49.1	16
6.8	60	18

From the studies on effect of cylinder speed and doffer speed, operational layer and transfer coefficient the following conclusion has been made.

With increase in cylinder speed there was a steady fall in Q, while K was higher at too higher cylinder speed, then at too low cylinder speed.

At given production rate the loading decreased and the coefficient of transfer increased with finer slivers i.e. at higher cylinder and doffer speeds.

While the result in respect of yarn strengths were erratic. The finest sliver did give the best appearance.

An increase in flat speed does not materially reduce the loading and increase the coefficient of transfer. The weight of strip / flat is reduced and there is some improvement in carding quality as judged by nepcount of web.

At a given cylinder speed and production rate finer sliver hanks and higher doffer speed result in less loading, better transfer to doffer and better yarn quality.

15

Table 6. Effect of Increased Cylinder and Doffer Speed On Fiber Mass Transfer

Cylinder speed	Q ₀ Reduction %	Q ₁ Reduction %	Q ₂ Reduction %	K%
180	-	-	-	4.90
220	17	20	17	4.92
260	41	40	41	5.76
315	52	40	52	5.82

2.7 CYLINDER -DOFFER ACTION [6]

It was stated that fibers on the cylinder were transferred onto the doffer and accumulated to form the doffer web as a result of opposing directions of the saw tooth wire clothing of each roller set in close proximity i.e. point to point action.

Ghosh and bahdur [4] report that tracer fibers were noted generally to go around the cylinder for several revolutions before being transferred by the doffer.

Debar and Watson [2] work showed that a fiber on the cylinder wire passes the doffer up to a maximum of 20 times before being removed by the doffer. With a continuity of fiber mass fiber mass flow through the card, this makes that the doffer web is built up over many cylinder revolution and recycling layer Q₂ is comprised of multiple fractioned layers of fiber mass transferred from taker in to cylinder during these cylinder revolutions.

16

Prof. A.R. Khare [5] report that, the intensity of carding is increased by decreasing the load on cylinder. This can be done by reducing the layer of fibers between them to a minimum. These can be divided into three sub groups: a) the fibers embedded in the cylinder wire foundation, b) operating layer consisting of store fibers which he cylinder acquires during its steady state, c) the fibers on the surface of the flats. The amount of fibers in the operational layer also depends upon hank of sliver. With finer hank, the fibers in operational layer reduce, thus including better carding action.

When the cylinder speed is increased keeping the production rate constant, the proportion of fibers transferred to doffer also improves. There is greater proportion of fibers transferred from cylinder to doffer. Obviously the amount of fibers in the operating layer decreases.

Incidentally, higher doffer speed also reduces loading on the cylinder. The arrangement of the clothing is not, as might have been expected, as stripping arrangement, but a carding arrangement. This is the only way to obtain a condensing action and finally to form a web. It has both advantages and disadvantages.

A disadvantage to be noted is that before transfer, some fibers remain caught at one end of the teeth of the main cylinder. During transfer, some of the projecting ends are caught by the clothing of the doffer and taken up. Most transferred fibers remain hanging as trailing hooks on the teeth of the doffer. However, aside from the serious disadvantages of hook formation, the carding effect is mentioned is produced here. since either main cylinder clothing rakes through the fibers caught in the doffer clothing rakes the fiber on the main cylinder.

17

2.8 MECHANISM OF FIBER TRANSFER AND HOOK FORMATION

It is observed that the individual fibers on the cylinder clothing as the cylinder surface leaves the carding zone and approaches the doffer transfer zone. Although the fibers from the cylinder to doffer not in form of web of fibers but as individual fibers.

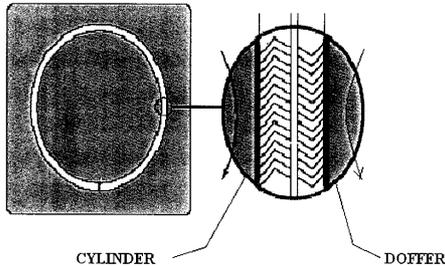


Fig 8. Mechanism of Fiber Transfer

Figure shows that the cylinder to doffer region can be divided into two zones. They are top and bottom zones. Fiber transfer from the cylinder to doffer largely occurs in the top zone. In the top zone the circumference of two rollers converges towards the setting line and they diverge away and form it in the bottom zone. So it is assumed that the mechanical action of transfer would take place mainly in top zone.

18

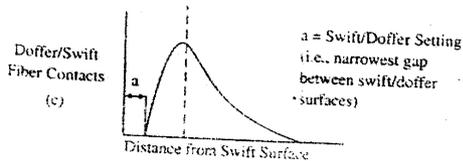


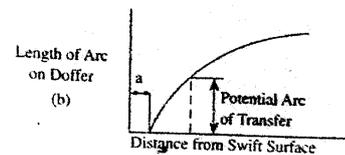
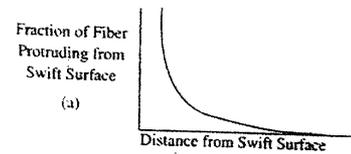
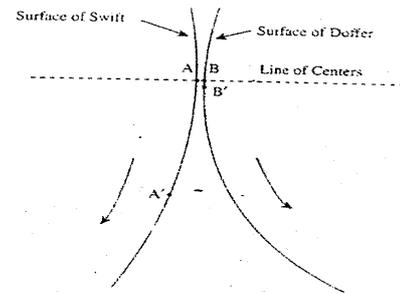
Fig 9. Cylinder- Doffer Transfer of Fiber

Mortan and summer's suggest that, as the trailing ends of fibers lift from the cylinder surface, some become hooked around teeth of doffer clothing. The doffer has steeper working angle and layer length of wire points than cylinder clothing. Therefore the frictional array of doffer clothing eventually removes these fibres.

Sengupta and Chattopadhyay [12] observations of fibers in the doffer web having trailing hooks without undergoing the reversal of their leading and trailing hooks. The second one is simply the leading hook fibers on the cylinder undergo reversal during transfer but without a change of configuration.

They proposed two mechanisms for the formation of leading hooks in the doffer web. The first is that some leading hooked fibers, particularly those near the tip of a saw tooth, slide off the cylinder clothing and lead on the doffer without reversal or change of configuration. The second is that other fibers slip from the cylinder with a reversal of trailing and leading hooks. The majority of fibers transfer in top zone, and increasing the ratio results in an increase in number of such fibers and a larger no of trailing than the leading hook fibers.

20



19

2.9 FRICTIONAL CONTACT POINTS [8]

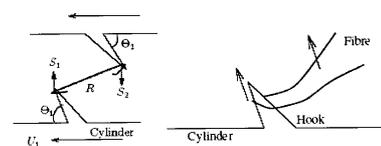
There are three possible ways in which a fiber may slip of the hook from which it is being tethered. The first we consider is when a fiber is held by two hooks and slips of the end of one. We can apply a fairly simple frictional analysis.

That indicates which hook will retain the fiber. Assuming the fiber is approximately parallel to the drum surfaces, a condition for slipping is

$$\cos \theta_1 + \mu_c \sin \theta_1 > \cos \theta_2 + \mu_d \sin \theta_2$$

Where $\mu_{c,d}$ are the frictional coefficients between the fiber and hooks on the cylinder and doffer. The fiber will stay on the bottom cylinder and when is not satisfied the fiber will transfer onto the doffer. There are two other possibilities for a fiber to transfer from cylinder to doffer. The first is when a fiber is removed from a hook purely by aerodynamic forces as described in the above figure and we can use the same inequality

$$\left| \frac{F}{N} \right| > \mu_d$$



Profile with two hooks

Profile with one hook

21

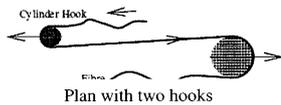


Fig 10. Friction Forces Acting On a Fiber: Connected to A Hook or a Couple of Hooks

The second is when one part of the fibre is dragged around and of one hook as shown in picture. For this case, we can assume the fibre held between the two hooks will stay on the cylinder if the following inequality is satisfied,

$$\mu_c a_c^2 > \mu_d a_d^2$$

where a_c and a_d are the radii of the cylinder and doffer hooks respectively. Inequality is a rather simple approach that approximated the hook cross sections to be circular, but even if this is not sufficient for some, the reader can envisage, certainly for this case, that the relationship will depend on hook architecture and in particular the surface contact. We have three conditions from the inequalities and, and these are not necessarily mutually exclusive.

According to the project investigation, card sliver has:

1. 50% of fibers have trailing hooks
2. 15% have leading hooks
3. 15% have both ends hooked
4. 20% without hooks

2.10 ESTIMATION OF HOOKS:

1. VISUAL METHOD

Viscose and polyester fiber dyed with trinopal kvm and trinopal wsm were used as tracer fiber. The tracers were mixed with untreated

fiber prior to carding. After carding, tracers were examined under UV light to study the pattern of hook formation.

2. LINDSLEYS METHOD

In this method, two parameters are chosen to represent the pattern of hook formation where the portion of curved fibers ends. P & $\%E$ which are represented by the following relation

$$P = E/(E*N) * 100$$

$$\%P = E/(C*E*N) * 100$$

Where,

C is the weight of combed out fiber

E is weight of fiber ends projecting over the line of cut after combing

N is weight if sliver portion clamped under the cutting plate after combing

Transfer factor vs nep generation

The neps are highly related to cylinder loading. For a given throughput the rate of cylinder loading increases rapidly with feed. With excessive humidity and damaged wire, the cylinder loading becomes a serious problem. Even when the cylinder wire gets contaminated with oil licking from crushed seeds or with waxy material present on the fiber surface and honey dew. All these cause the cylinder loading which leads to excessive nep generation. Cylinder loading leads to more reworking of fibers and hence cause more neps.

2.11 FACTORS AFFECTING TRANSFER COEFFICIENT [6]

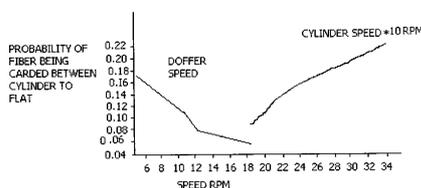
There are two actions that form the recycling layer; the first is retaining power of cylinder. The leading ends of most fiber are hooked on the cylinder & resist the transfer of fiber in spite of circular and centripetal force.

Retaining power of cylinder \propto (1/ surface speed of cylinder)

The second action is robbing back of the cylinder. The fibres which are protruding beyond the total distance of tooth height plus the cylinder to doffer settings will be subsequently caught by cylinder Clothing moving towards the setting line.

The transfer coefficient is governed by the tooth angle, tooth density, circular motion & diameter of cylinder and doffer. These factors influence the effectiveness of the two rollers to hold fibres on to their respective clothing i.e. their retaining power & there by determine the transfer coefficient K .

Fig 11. Cylinder / Doffer Speeds Vs Carding Action



Greater the ratios of cylinder-doffer tooth angles, surface speed, lower Q2. However, a change in roller diameter has less effect than changes in tooth angles.

SUMMARY

The mechanical doffer does not completely transfer the fiber on the cylinder surface. This leads to build up of operational layer and cylinder loading which leads to NEP generation and hook formation. Operational layer and cylinder loading reduces the performance of carding machine. Therefore transfer coefficient has to be enhanced.

3. OBJECTIVE

3.0 OBJECTIVE

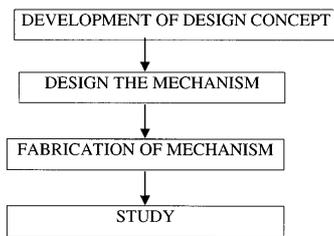
- i) To analyze the doffing mechanism in the revolving flat card and to design the mechanism for achieving enhanced transfer coefficient.
- ii) To fabricate the selected alternatives for doffing mechanisms.
- iii) To compare the two systems of designs, compressed air and direct suction.

4. METHODOLOGY

26

27

4.0 METHODOLOGY



LAP PARTICULARS

- Lap weight : 13.5 Kgs
- Lap length : 26Mts
- Grams/ meter: 519 g/m
- Lap hank : 0.0011

CALCULATION

To maintain the surface speed ratio between cylinders to front roller surface we are keeping 4% as the constant.

0.04% Surface speed of the cylinder = surface speed of the front roller

$$\text{Speed of the front roller} = \frac{\pi * 50 * 25.4 * 198 * 0.04}{\pi * 35.6} = 282.53 \text{ rpm}$$

$$\text{Diameter of front roller pulley} = \frac{(18.5 * 198)}{282.53} = 13 \text{ inch}$$

$$\text{Speed of back roller} = \frac{282.53 * 35.6}{82.6} = 121.76$$

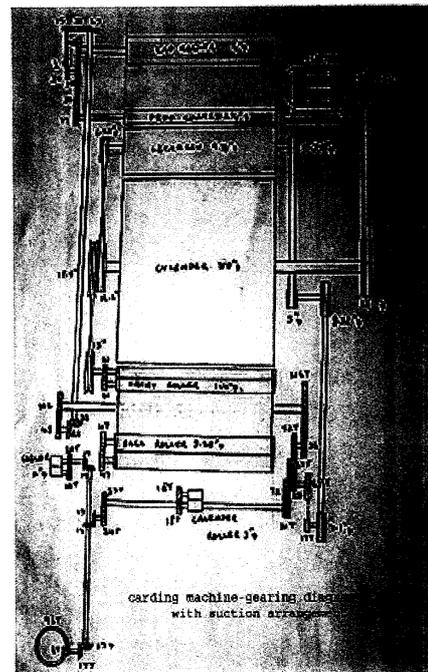


Fig 12. Modified Gearing Diagram for design- 1

5. DEVELOPMENT OF DESIGN CONCEPT

5.1 DESIGN-1

DESIGN OF SUCTION ARRANGEMENT USING NOZZLE

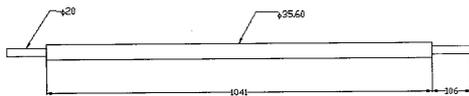
The suction arrangement consists of two pair of rollers, conveyer belt, driving units, roller hood, condensing unit, nozzle and cover. The fabrication arrangements are shown in fig. Here air jet principle is applied to create the suction pressure. In this suction unit compressed air is used to create the negative suction pressure. At 12 kgs / cm² compressed air is passed to the nozzle. The delivers around the surface of the nozzle, and creates suction pressure.

The suction pressure is utilized to collect the fibers from the cylinder surface. The fibers are passed between the conveyer belts, which helps to better orientation of fibers and to control the movement of fibers. Then the fibers are condensed by the condensing unit. The surface speed of the front roller is kept as 4% of the cylinder surface speed.

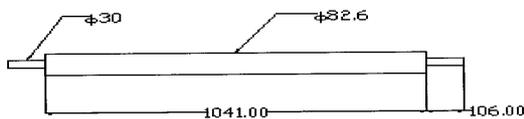
The fibers are now in sliver form and passed through the 16mm hole in the nozzle. A pair of delivery roller is employed to collect the sliver.

5. DEVELOPMENT OF DESIGN CONCEPT

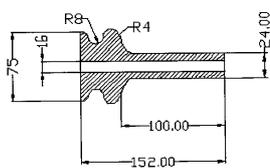
FRONT ROLLER



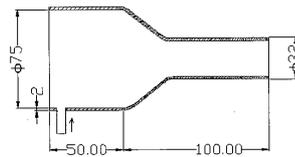
BACK ROLLER



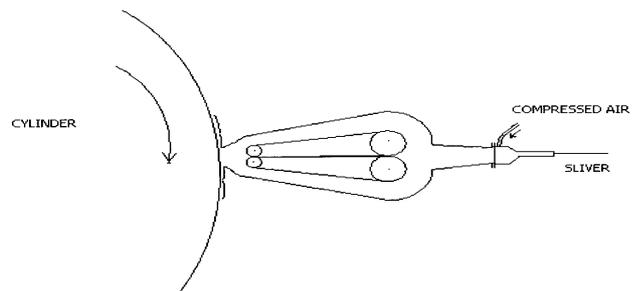
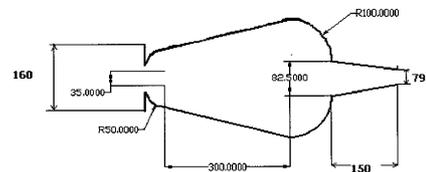
NOZZLE



NOZZLE COVER



ROLLER HOOD AND CONDENSING ZONE



Design-1. SIDE VIEW OF SUCTION ARRANGEMENT

Fig 13. COMPONENTS FOR DESIGN 1

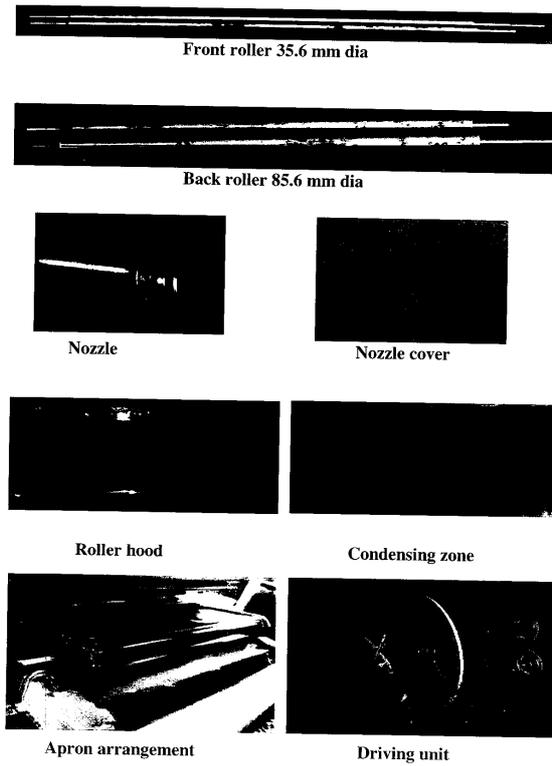
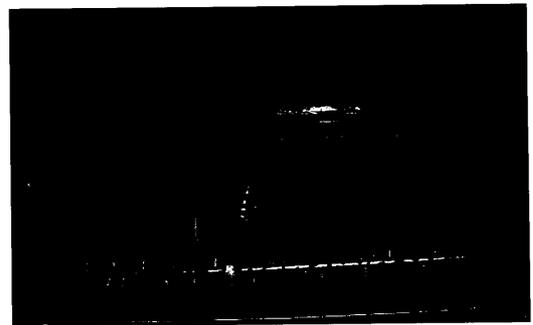


Fig 14. DESIGN 1

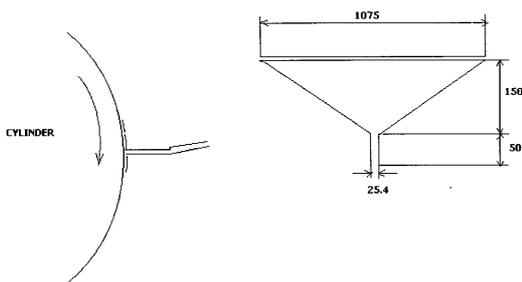
Normal carding machine



Design-1
Suction arrangement fixed at front middle plate of the cylinder



5.2 DESIGN 2:
DESIGN OF SUCTION ARRANGEMENT



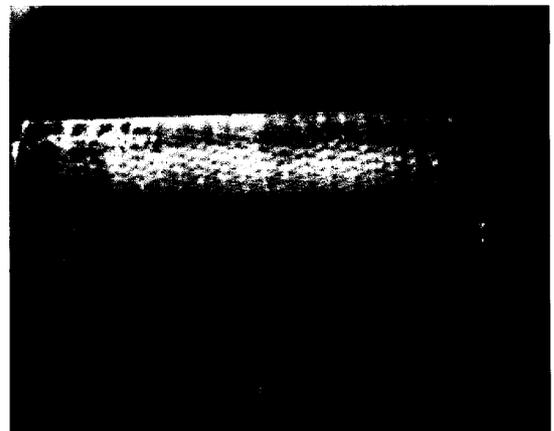
With reference to a previous project, suction is made in cylinder area for 2inch width. Now we have made it for full width of cylinder. Where we used a suction hood to the width of cylinder and height 200mm.its cross section is 8mm. and suction hose of diameter of 25.4 mm. this arrangement is fitted near the front plate of cylinder with an opening of 7mm. Here 6 cm water column pressure is used.

This arrangement uses the principle of suction pressure to doff the fiber from the cylinder clothing. The fiber is collected in the suction unit. So fiber is doffed within one revolution of the cylinder, thus efficacy of carding is increased.

FIG 15 DESIGN 2- DIRECT SUCTION ARRANGEMENT



Suction hood



Suction arrangement attached with front middle plate of the cylinder

6. RESULT:

Table 7. Normal sliver

NO. of cells with nep	Neps/100 inch ² of web
8	27
10	35
8	27
9	31
9	31
Avg.	30.2

Table 8.Design 1

NO. of cells with nep	Neps/100 inch ² of web
7	23
6	19
8	27
6	19
7	23
Avg.	22.2

Table 9.Design 2

NO. of cells with nep	Neps/100 inch ² of web
9	31
7	23
8	27
8	27
9	31
Avg.	27

6. RESULT

38

39

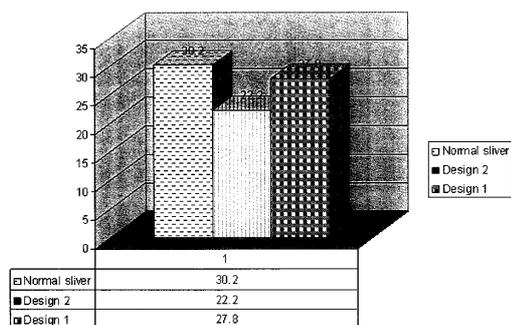


Fig 16. Neps/100 square inch of web

From the table 7, 8, 9& fig 16 it is clear that the neps per 100 sq.inch of web of design 2 is better than that of normal sliver and design 1

LAP –FIBER LENGTH

Table 10.Fiber length

S.NO	50% SPAN LENGTH	2.5% SPAN LENGTH	UR	AMOUNT
1	13.8	30.8	44.8	662
2	13.7	28.4	47.7	675
3	13.5	30	47.5	659
4	14.2	31.5	47.3	625
5	14.6	28.5	46.3	657
Avg	14.0	29.9	46.7	
CV%	3.1	4.4	2.6	

40

Table 11.Fiber fineness of normal sliver

S.NO	MICRONAIRE (µg/inch)	FINENESS (millitex)	MATURITRY COEFFICIENT	PERCENTAGE MASS DEVIATION%
1	4.05	158	.82	73
2	4.10	158	.82	73
3	4.05	159	.82	73
4	4.05	163	.85	75
5	3.80	163	.84	75
Avg	4.00	160	.8	74
CV%	3.00	2.00	1.7	1

SLIVER TESTING – Normal Table 12.Fiber length

S.No	50% SPAN LENGTH	2.5% SPAN LENGTH	UR	AMOUNT
1	13.5	29.8	45.3	744
2	13.2	27.4	48.2	702
3	13.0	26.8	48.5	628
4	12.4	28.1	44.1	558
5	12.9	28.2	45.7	719
Avg	13.0	28.1	46.4	
CV%	3.1	4.0	4.1	

41

Table 13. Sliver hank of normal sliver

S.NO	SLIVERWEIGHT (6Yds - in Gms)	SLIVER HANK
1	33.43	0.105
2	41.766	0.084
3	27.064	0.103
4	28.048	0.120
5	34.218	0.103
6	30.24	0.117
7	33.08	0.107
8	34.96	0.101
9	35.38	0.10
10	32.76	0.108
AVG	33.09	0.106

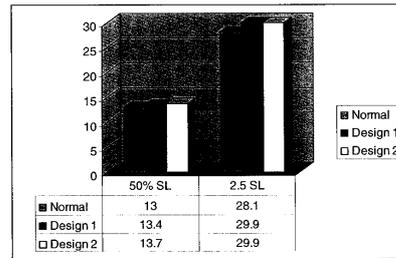
Table 14.Design 1- Fiber length

S.No	50% SPAN LENGTH	2.5% SPAN LENGTH	UR	AMOUNT
1	13.2	29.7330.8	44.4	634
2	13.6	28.4	46.7	665
3	13.8	30	47.3	629
4	13.5	29	47.8	676
5	13.1	30.6	46.1	665
Avg	13.4	29.9	46.5	
CV%	2.9	3.9	3.7	

Table 15.Design 2 -Fiber length

S.No	50% SPAN LENGT H	2.5% SPAN LENGT H	UR	AMOUN T
1	13.8	30.8	44.8	634
2	13.7	30.6	44.4	665
3	13.9	30	47.4	629
4	13.5	31	46.6	676
5	13.6	28.4	47.7	665
Avg	13.7	29.8	46.68	

Fig 17. Span length -chart



From the table 12,14 &15 it is clear that the average span length of the design 2 is better than design 1 and normal sliver due to absence of hook formation.

7. CONCLUSION

The following conclusions are drawn from the studies.

- i) Doffing using nozzle & compressed air conveyor system don't induce complete suction from the cylinder surface. Adapting the system without conveyor and decreasing the distance of the nozzle from the cylinder surface can improve the performance.
- ii) Doffing with direct suction was effective in doffing the fibers.
- iii) Improvement in terms of nep level in the carded material was found to be better than the conventional doffing.
- iv) Improvement in average span length of fibers has also been observed with new doffing designs.

7. CONCLUSION

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