© 2018 IJSRSET | Volume 4 | Issue 4 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section : Engineering and Technology

Design Modification and Analysis of Double Roller Mini Ginning Machine

Lokesh K. Atel*[1], Dr. M. J. Sheikh[2]
[1]Research Scholar, Bapurao Deshmukh College of Engineering, Sewagram, Maharashtra, India
[2]Professor, Bapurao Deshmukh College of Engineering, Sewagram, Maharashtra, India

ABSTRACT

Indian Cotton Ginning Industry is the second largest in the world. Cotton ginning plays very important role of separation of fibers from cotton seed and converts field crop into a saleable commodity i.e. lint. Ginning acts as a bridge between cotton farmer and textile industry. In India, cotton is ginned on double roller gins manufactured domestically. Indian Ginning Industry has been transformed into remunerative business enterprise and has achieved global leadership in supply of quality cotton to domestic as well as international textile mills .There is a need to design and enhance the Double roller Ginning Machine to benefit the textile industries. The analysis of existing design has been carried out. This research presents design modifications and CAD model of Double Roller Ginning Machine. The analysis of modified design has been performed and the results were critically discussed.
Keywords: Lint, Ginning Machine.

I. INTRODUCTION

Ginning is the mechanical process for separating cotton into its constituents namely lint (Cotton Fiber) and Cotton Seed. The Seed Cotton that comes from the field has to be subjected to various treatments in the ginning factories depending upon its inherent characteristics such as trash contents, moisture contents, length of the fiber, variety of seed i.e. fuzzy or black, method of seed cotton transportation, storage practices, handling practices inside the ginning factories and finally subjected to ginning process for separation of fiber and seed before packing into bales etc.

Ideally the quality of the constituents i.e. cotton fiber and cotton seed before ginning and after ginning must be more or less same however it is seen that substantial damage is caused to quality parameters during processes in the ginning factories.

The selection of cotton for spinning is made on the basis of fiber quality and any damage in the same during the process of ginning reduces the value of the fiber and results in lowering down of value in total textile value chain. The development of high speed spinning and weaving machinery has necessitated requirement of better cotton fiber parameters and any damage in quality caused while ginning cannot be rectified later and the defect is carried forward to yarn and fabrics during spinning and weaving process. The economics of ginning operation depends upon the proper selection of ginning technology suitable for various characteristics of the seed cotton to optimize the quality parameters and operational costs, thus the selection of suitable ginning technology is of paramount importance.

II. DOUBLE ROLLER GINNING MACHINE

It consists of two spirally grooved leather roller pressed against a fixed knife and a pulley and belt drive mechanism. Two moving blades combined with seed grids constitutes a central assembly known as beater which oscillates by means of a crank or eccentric shaft, close to the fixed knife.

When the seed cotton is fed to the machine in action, fibers adhere to the rough surface of the roller are carried in between the fixed knife and roller in such a way that the fibers are partially gripped between them. The oscillating knife beats the seed and separates the fibers. This process is repeated for number of times and due to push-pull-hit action the fibers are separated from the seed, carried forward on the roller and dropped out of machine. The ginned seeds drop down through the grid which is oscillating along with beater.

III. DATA ACCUMULATION & CALCULATIONS

In present study, we have accumulated all the essential and necessary data of existing DR Ginning machine and carried out the design calculations to create the existing CAD model of DR Ginning machine.

Existing machine Data:

Data obtained from the existing machine:

Rated Power = 1 HP , Power factor = 1.1

Speed = 1425 RPM

The machine output capacity is 25-30 kg/hr.

The optimum roller speed is 140 rpm

The leather roller available is of diameter of 150 mm

Two rollers rolling in opposite direction with roller speed of 140 RPM,

1HP motor with 1425 RPM used

Roller 1 is connected with motor by means of belt and pulley reduction mechanism

Roller 2 is connected with motor with gear reduction and small pulley reduction mechanism

as shown in below,

Roller 1 drive mechanism:

Roller 1 drive mechanism

Rated Power of motor

$$P_R = 746\, Watt$$

Design Power,

$$P_d = P_R \times K1$$

$$P_d = 746 \times 1.1 = 820.6\, Watt$$

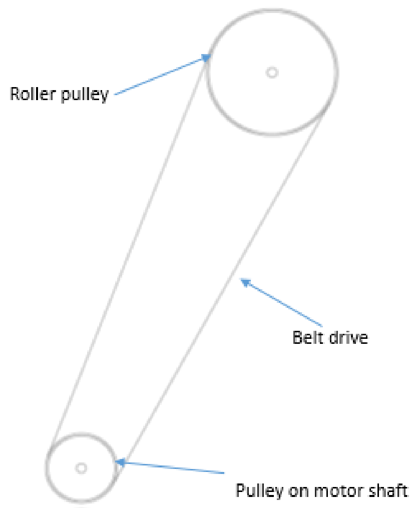

Figure 1

From design data book

Designation A,

Normal width of pulley = 13mm

Nominal thickness = 8mm

Motor Pulley diameter(D1) = 75mm

Roller pulley diameter = D2

No. of strands = 6

Speed of motor (N1) = 1425 rpm

Speed of roller pulley = N2

$$\frac{N1}{N2} = VR = 10.17$$

$$\frac{D1}{D2} = VR$$

$$D2 = 75 \times 10.17 = 765mm$$

Length of belt,

Center distance = 75 + 765 = 840 mm

$$L = \left(\frac{\pi}{2}\right)(D1 + D2) + 2C + \frac{(D1 + D2)^2}{4C}$$

$$L = \left(\frac{\pi}{2}\right)(75 + 765) + 2(558) + \frac{(50 + 508)^2}{4(840)}$$

$L = 3208.8\, mm$

Consider coefficient of friction between belt and pulley, μ = 0.3

For an open belt angle of contact,

$$\sin \propto = \frac{r1 - r2}{x}$$

$$\propto = \sin^{-1}(0.41)$$

$$\propto = 24.2$$

$$\theta = 180 - 2(24.2) = 131.6$$

$$\theta = 131.6 \times \frac{\pi}{180} rad = 2.29\, radian$$

T1 = tension in tight side

T2 = tension in slack side

$$\frac{T1}{T2} = e^{\mu\theta}$$

$$\frac{T1}{T2} = e^{0.3 \times 2.29} = 1.987$$

$$T1 = 1.987T2$$

Where velocity of belt,

$$v = \frac{\pi d_2 N_1}{60}$$

$$v = \frac{\pi \times 75 \times 1425}{60}$$

$$v = 5.6\, m/s$$

$$P = \frac{(T1 - T2)v}{1000}$$

$$0.746 = \frac{(T1 - T2) \times 5.6}{1000}$$

$$(T1 - T2) = 133.2\, N$$

Substitute the value of T1 from tension ratio

$$1.987T2 - T2 = 133.2$$

$$T2 = 134.95N$$

$T1 = 268.14\, N$

Initial Belt tension,

$$To = \frac{T1 + T2}{2}$$

$$To = 201.5\, N$$

Pulley1 is connected directly on motor shaft

Pulley1 torque = 5 N.m

Torque acting on Driven pulley

$$Tdriven = \frac{(T1 - T2)Ddriven}{2}$$

$$T_{driven} = \frac{(200.1) \times 0.508}{2} = 50.8\, N.m$$

Pulley Torque and speed ratio,

$$Tdrive \times N1 = Tdriven \times N2$$

$$N2 = \frac{5 \times 1425}{50.8} = 140\, RPM$$

Roller 2 drive mechanism:

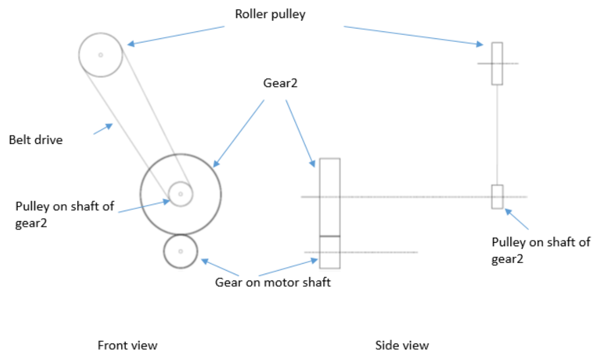

Figure 2

Roller 2 drive mechanism

Rated Power of motor

$$P_R = 746\, Watt$$

Design Power,

$$P_d = P_R \times K1$$

$$P_d = 746 \times 1.1 = 820.6\, Watt$$

Gear1 of 19 teeth connected on the motor shaft, meshed with gear2of 89teeth

Hence,

t3 = 19 and t4 = 89

N3=1425 rpm

Gear ratio is given by,

$$\frac{t4}{t3} = \frac{N3}{N4}$$

$$N4 = 304rpm$$

Small pulley rotating on the same shaft of gear2 and large pulley on roller2,

Small pulley speed (N5) = 304 rpm

roller pulley (N6) = 140 rpm

From data book

Designation A,

Normal width of pulley = 13mm

Nominal thickness = 8mm

Pulley diameter(D5) = 75mm

Roller pulley diameter = D6

No. of strands = 6

$$\frac{N5}{N6} = VR = 2.17$$

$$\frac{D5}{D6} = VR$$

$$D6 = 75 \times 2.17 = 162.8\,mm = 163\,mm$$

Length of belt,

Center distance = 75 + 163 = 238mm

$$L = \left(\frac{\pi}{2}\right)(D5 + D6) + 2C + \frac{(D5 + D6)^2}{4C}$$

$$L = \left(\frac{\pi}{2}\right)(75 + 163) + 2(238) + \frac{(75 + 163)^2}{4(238)}$$

$$L = 909mm$$

Consider coefficient of friction between belt and pulley,

μ = 0.3

For an open belt angle of contact,

$$sin \propto = \frac{r1 - r2}{x}$$

$$\propto = sin^{-1}(0.18)$$

$$\propto = 10.36$$

$$\theta = 180 - 2(10.36)$$

$$\theta = 159.28 \times \frac{\pi}{180} rad = 2.78\,radian$$

T3 = tension in tight side

T4 = tension in slack side

$$\frac{T3}{T4} = e^{\mu\theta}$$

$$\frac{T3}{T4} = e^{0.3 \times 2.78} = 2.3$$

$$T3 = 2.3T4$$

Where velocity of belt,

$$v = \frac{\pi d_5 N_5}{60}$$

$$v = \frac{\pi \times 75 \times 304}{60}$$

$$v = 1.194\,m/s$$

$$P = \frac{(T3 - T4)v}{1000}$$

$$0.746 = \frac{(T3 - T4) \times 1.194}{1000}$$

$$(T3 - T4) = 624.8\,N$$

Substitute the value of T3 from tension ratio

$$2.3T4 - T4 = 624.8$$

$$T4 = 480.6\,N$$

$$T3 = 1105.38\,N$$

Initial Belt tension,

$$To = \frac{T3 + T4}{2}$$

$$To = 792.9\,N$$

Actual RPM and torque transmission from motor to roller:

Motor RPM = 1425 RPM

Motor Power = 746 watt

Torque of motor,

$$P = \frac{2\pi NTmotor}{60}$$

$$746 = \frac{2 \times \pi \times 1425 \times Tmotor}{60}$$

$$Tmotor = 5\,N.m$$

Gear speed and Torque ratio,

$$\frac{Tgear1}{Tgear2} = \frac{t1}{t2}$$

$$Tgear2 = \frac{89}{19} \times 5 = 23.4\,N.m$$

Gear 2 and pulley 1 is connected on same shaft, pulley1 torque = 23.4 N.m

Torque acting on Driven pulley

$$Tdriven = \frac{(T3 - T4)Ddriven}{2}$$

$$T_{driven} = \frac{(1105.38 - 480.6) \times 0.163}{2} = 50.9\,N.m$$

Pulley Torque and speed ratio,

$$Tdrive \times N5 = Tdriven \times N6$$

$$N6 = \frac{23.4 \times 304}{50.9} = 140\,RPM$$

The critical design parameters were identified and design modifications in the existing design has been carried out.

Trail 1:

To determine the capacity of machine theoretically.

Roller length= 500 mm, Roller speed= 140 rpm

The weight of cotton that occupies the space where the ginning is taking place= 30gms

Rotation of roller to process 30gms of cotton= 20 rotation of 140 rpm.

Cotton processed in 1 min= 140/20 x 30 = 210gms/min

Cotton processed in 1 hr= 210 x 60 = 12600gms = 12.60Kg/hr

Therefore, 12.60Kg/hr is the capacity of one roller For two rollers = 2 x 12.60 = 25.20 kg/hr Hence theoretically the capacity of the machine will be approximately 25-30 kg/hr.

If Roller length= 700 mm, ii. Roller speed= 140 rpm)

The weight of cotton that occupies the space where the ginning is taking place= 42gms

$$\frac{700 * 30}{500} = 42\text{gms}$$

Rotation of roller to process 42gms of cotton= 20 rotation of 140 rpm.

Cotton processed in 1 min= 140/20 x 42 = 294gms/min

Cotton processed in 1 hr= 294 x 60 = 17640gms = 17.64Kg/hr

Therefore, 17.64Kg/hr is the capacity of one roller For two rollers = 2 x 17.64 = 35.28 kg/hr

Hence theoretically the capacity of the machine will be approximately 35-40 kg/hr.

Trail 2:

Line diagram of ginning machine:

Neglecting gear mechanism used for opposite rotation, Mechanism with pulleys shown in the figure rotating in the clockwise direction

Separate lint collector and feed required

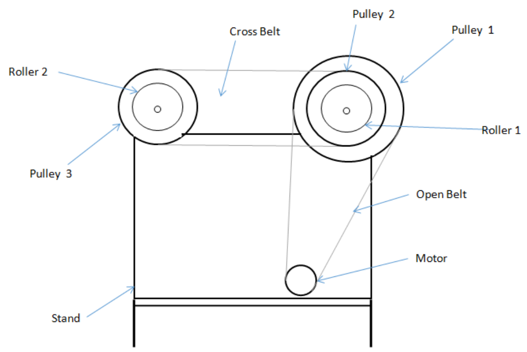

Figure 3

Knife Tool Life Calculations:

Stainless steel blade bears the following calculated loads,

Force required to separate 1 seed is 34.76 N (mean of observed value) assuming 8 seeds will come in contact with blade while operation

Hence, Force = 8 x 34.76 = 278.32 N

This is the force on blade due to seed separation.

Tool wear calculations:

Failure by gradual wear, which is inevitable cannot be prevented but can be slowed down only to enhance the service life of tool.

The cutting tool is withdrawn immediately after it fails or if possible just before it totally fails. for that one must understand that the tool has failed or is going to fail shortly. It is understood or considered that the tool has failed or about to fail by one or more of the following conditions.

- Total breakage of tool or tool tip
- Massive fracture at the cutting edge
- Excessive increase in cutting forces and vibrations
- average wear (flank and crater)

Assuming Tailors tool life equation,

This relationship is credited to F. W. Taylor (~1900)

$$vT^n = C$$

where v = cutting speed; T = tool life; and n and C are parameters that depend on feed, depth of cut, work material, tooling material, and the tool life criterion used

- n is the slope of the plot
- C is the intercept on the speed axis

Typical Values of *n* and *C* in Taylor Tool Life Equation

Tool material	n	C (m/min)	C (ft/min)
High speed steel:			
Non-steel work	0.125	120	350
Steel work	0.125	70	200
Cemented carbide			
Non-steel work	0.25	900	2700
Steel work	0.25	500	1500
Ceramic			
Steel work	0.6	3000	10,000

Figure 4. Typical values of n and C

considering High Speed steel with non steel work,

n = 0.125

C = 350

v = 140 rpm = 66 m/min

$$66 \times T^{0.125} = 350$$

$$T = 625421.8\ cycle$$

Table 1

PARTS	Existing machine	Modified Machine	Description
Pinion	89	89 teeth	-
Gear	19	19 teeth	-
Pulley1	600 mm	Diameter = 765mm	For Equal speed of both rollers at 140 rpm
Pulley2	100 mm	Diameter = 75 mm	For Equal speed of both rollers at 140 rpm
Pulley3	202 mm	Diameter = 163 mm	For Equal speed of both rollers at 140 rpm
Gear Mechanism(Experiment 1)	Present	Remove	Both Rollers rotate in same direction
Roller Length(Experiment 2)	500 mm	700 mm	Productivity of M/C may increase

IV. CONCLUSIONS

The result of the research predicts the considerable enhancement in the tool life. The modifications in design of DR ginning machine removes almost all difficulties found with existing machine. Hence it can be concluded that the productivity will increase to a considerable extent. The down time required for overhauling and restoring the components in machine like belts, etc as observed in existing machine, will be reduce significantly and thus the reliability of the product will be increased.

V. REFERENCES

[1]. IJIRST –International Journal for Innovative Research in Science & Technology| Volume 3 | Issue 03 | August 2016 ISSN (online): 2349-6010 Design and Fabrication of Mini Saw Cotton Ginning Machine Bhushan S. Umarkar Prof. P. G. Mehar

[2]. Recent Advances in Cotton Ginning Technology in India Dr. P.G. Patil1 & Er. V. G. Arude2; 1Director, Central Institute for Research on Cotton Technology, (ICAR), Mumbai, India, Email: pgpatil266@gmail.com, 2Scientist. Central Institute for Research on Cotton Technology, (ICAR), Mumbai, India, Email: arudevg@gmail.com

[3]. International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 1, January- 2013 ISSN: 2278-0181A Review on Design and Development of Eccentric Shaft for Cotton Ginning Machine Amol Kurle1 Prof. L. P. Raut2,

[4]. Automation in cotton ginning Article in International Journal of Intelligent Systems February 2004 DOI: 10.1002/int.10156 Source: DBLP Murali Siddaiah 1 , Michael A. Lieberman 2 Nadipuram R. Prasad 4 and S. E. Hughs 3 Klipsch School of Electrical Southwestern Cotton Ginning and Computer Engineering Research Laboratory Las Cruces, NM 88003 USDA-ARS, Mesilla Park, NM 88047

[5]. New Developments in Cotton Ginning (A Paper presented at the Fourth Breakout Session on Thursday, November 20, 2008 during 67th Plenary Meeting of the ICAC in Ouagadougou, Burkina Faso by Mr. M.K. Sharma, President, – Bajaj Steel Industries Limited, Nagpur-440 018 India .

[6]. Development of Prototype Double Roller Gin with Improved Power Transmission and its Performance Evaluation. Prashantkumar Gulabrao Patil, Vaishali Patil Central Institute for Research on Cotton Technology, Maharashtra, INDIA.

[7]. Study of ginning and pressing mills p.bharath ,k.raju ,m.vigneshwar ,r.rohit ,dr.v.v.prathibha bharathi1234 students of mrce HOD of mechanical department.

[8]. Double Roller Auto Feeder Ginning Machine Noise Parameters and its Effects on Operator and Related Hazards Sachin Gajghate Mr. Vaibhav Bankar Research Student (CAD/CAM) Assistant Professor (CAD/CAM) Department of Mechanical Engineering Department of Mechanical Engineering Vidarbha Institute of technology, RTMNU University, Nagpur Vidarbha Institute of technology, RTMNU University, Nagpur.