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Design and Fabrication of Suction Duct for Cottonseed

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Abstract – *Ginning is a process of separation of cotton lint from cotton seed. At max of the ginning centre, double roller cotton gin is used for this purpose. Before actual ginning process, cottonseed is transferred from heap to pre-cleaner to clean the cottonseed. For this purpose, conveyor belt is used. It is observed that motor running the conveyor belt oftenly breaks down because of jamming of cotton particles in conveyor motor.*

Hence an alternative is provided for conveyor belt system. A sheetmetal duct is designed and fabricated to transfer cottonseed from cottonseed heap to pre-cleaner which will avoid system break down.

Key Words: Cottonseed, ginning, sheetmetal duct

1.INTRODUCTION

Ginning is the first mechanical process involved in processing cotton. Ginning mill separates cotton fibers from the seed bolls and dust particles. The main application of ginned cotton referred to as lint is for spinning operations, where lint is converted to yarn.

Indian Cotton Ginning Industry is the second largest in the world. Cotton ginning plays very important role of separation of fibres from cottonseed 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. About 36.5 and 38 million bales were ginned during 2012-13 and 2013-14, respectively in about 1500 modern and 2500 semi-modern ginneries. By introduction of efficient ginning, pre and post cleaning and novel material handling machinery along with implementation of skill development programmes, 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.

A cotton gin is a machine that quickly and easily separates Cotton fibers from their seeds, allowing for much greater productivity than manual cotton separation. The fibers are then processed into various cotton goods such as linens, while any undamaged cotton is used largely for textiles like clothing. Seeds may be used to grow more cotton or to produce oil.

Ajanta caves of India yield evidence of a single-roller cotton gin in use by the 5th century. This cotton gin was used in India until innovations were made in the form of foot powered gins. The cotton gin was invented in India as a mechanical device known as a charkha, more technically the "wooden-worm-worked roller". This mechanical device was, in some parts of India, driven by water powered cottonseed oil.

2. COTTON INDUSTRIES STATUS IN VIDHARHA

The Maharashtra government is working on a comprehensive policy to integrate six distressed districts of Vidarbha through 80 per cent cotton industry to restore its tag of “white gold”. The policy intends to address problems of farmers in the country’s largest cotton growing belt across Nagpur, Amravati, Akola, Buldhana, Yavatmal, Washim and Wardha.

In the 2016-17 budget, it plans to earmark special allocation to promote cotton based industries in Vidarbha to address its socio-economic problems. Chief Minister Devendra Fadnavis directed the officials to expedite work to transform Amravati district as the international textile hub of country. The detailed plan includes integrating three nodal departments of textile, finance and agricuture, to work towards attaining the target of the ambitious project.

The state government intends to promote the textile sector through public-private-partnership. Vidarbha is amongst the maximum cotton growing region of India. It contributes 30 per cent of the crop. Next is Marathwada.

Highly placed sources in the government revealed, “As part of the farm-to-fashion drive, the state government will spend Rs 2,000 crore in the region.”

What is lacking is a value added chain to integrate farmers with the textile industry. Maharashtra had been pushing hard to seek higher minimum support price from the centre for cotton.

However, the centre has fixed MSP at Rs 4,100 per quintal. A senior officer in the ministry of cooperation and marketing said, “The process of cotton procurement is on with outlets including Nagpur, Auranagabad. The Maharashtra State Co-Operative Cotton Growers Marketing Federation (MSCCGMF) procured around 39641 quintals till now. The target of 100 lakh quintal is higher than last season’s 27 lakh quintal.

The pilot project under the "farm to fashion" is sanctioned in Amravati, the second biggest city after Nagpur in Vidarbha region. At Nandgaon, 500 hectares of land has been approved for the textile hub which has received proposal from eight players. The work has already started. The primary concern of the state government is to provide basic infrastructure to make industries more conducive. Maharashtra Industrial Development Corporation will play facilitator for providing land for the textile sector in Amravati, spread across 500 hectares at Nandgaon.

It is estimated that all cotton related small and medium scale industries would be promoted in the region including maximum cotton spinning mills in Akola, Buldhana, Yavatmal, Washim.

3. PROBLEM IDENTIFICATION

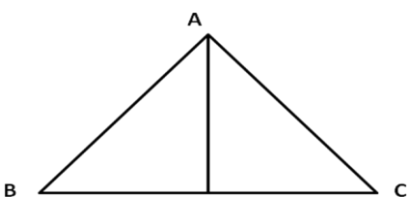
During industrial visit at Nirmal Ginning and Processing, it is observed that emergency breakdown of ginning process occurred because failure of hard box. After further investigation of breakdown, following conclusions are drawn.

1. Motor used to rotate conveyor belt was not working because of choking of seed cotton in motor which was left uncollected.
2. Continuous maintenance of conveyor motor reduces the overall motor life.
3. Amount of seed cotton remained uncollected after collection of seed cotton from cotton hip is mainly responsible for breakdown of hard box.
4. Hence extra manpower is needed to collect the seed cotton remained.

Hence it is felt that, replacement of conventional motor conveyor system for seed cotton collection from cotton hip would reduce the maintenance cost. Hence it is decided to design a sheet metal duct which will collect seed cotton directly from the cotton hip will directly deliver to pre-cleaner.

4. DESIGN CALCULATIONS

Conventional belt conveyor system is replaced by a sheet metal duct which suck the cottonseed from the heap will will transfer it directly to pre-cleaner. Following are the various design calculations for the suction duct.



1) Area of dome:-

Area of front side:-

Circumference area = a + b + c

= 457 + 660 + 803 =1920 mm^2

Similarly,

For circumference area = a + b + d

= 457 + 660 + 803 = 1920 mm^2

Total front area= 1920 + 1920 = 3840 mm^2

Similarly, Total back area = 3840 mm^2

Total front & back Area =7680 mm^2

Circumference of left side = 2 × (h + w) = 2 × (803 + 152) =1910 mm^2

Circumference area of right side = 1910 mm^2

Total Left & Right Area = 1910 + 1910 = 3820 mm^2

Total Area of Dome = 7680 + 3820 = 11500 mm^2

2) Area of Suction Pipe

Circumference Area of Suction Pipe = $2\pi rh = 2\pi \times 114 \times 2032$ = 1.45×10^6 mm^2

Total Area of Duct = Area of dome + Area of suction pipe

= $11500 + 1.45 \times 10^6$ = 1461×10^3 mm^2

Weight of duct = Area × Thickness of sheet × density of sheet material

= $1461 \times 10^3 \times 10^{-6} \times 1 \times 10^{-3} \times 7850$ = 11.46 kg

Total force acting on duct = Wt × g = 11.46 × 9.81 = 112.43 N

Design of bolt

Select major bolt diameter (d_b), d_b> 18mm

Assume next even value i.e. d_b = 20 or 22mm

Assume d_b = 20 mm

Calculate pitch circle diameter (PCD) of bolt, Cover with bolt,

$l = t_b + d_b + 5$ (P.N. 101, D.DB.)

l = distance of centre of bolt from corner of wall

l = 5 + 20 + 5

l = 30mm

$t_f = 1.25\ d_b = 1.25 \times 20$

t_f = 25mm

PCD of bolt =Di + 2l

PCD =150 + (2 × 30)

PCD = 210mm

To find no. Of bolts (n),

Pitch, p =3.5 d_b

For pressure > 1.4 MPa (PN. 101, D.D.B.)

p= 3.5 × 20

p= 70mm

No. Of bolts,

n= (PCD × π) / pitch

n= (210 × π) / 70

n = 9.42 ≅ 10

n = 10

5. FABRICATION OF DUCT

According to duct designed in previous chapter, fabrication of the same is needed. Duct is fabricated at company site itself. Fabrication, transportation and installation of duct costs Rs. 80,000.

Fig -1: Suction Duct

6. CONCLUSIONS

Duct which is designed and fabricated is installed at Nirmal Ginning and Processing Nagpur. After analysing performance of duct, following conclusions are drawn.

1. It helps to reduce wastage of seed cotton.
2. Time taken to transfer seed cotton from heap to pre-cleaner is reduced considerably.
3. As the suction duct work semi-automatically, less manpower is required.
4. It is observed from past record that maintenance of conveyor system is more than that of fabrication, transportation and installation of suction duct.

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