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BELT CONVEYOR SYSTEM FOR SMART ONION SORTING MACHINE

Pagar Vicky Madhavrao[1]

[1]*Mechanical Engineering, SNJB's Late Sau. Kantabai Bhavarlalji Jain College of Engineering, Chandwad, India*
vickypagar5522@gmail.com [1]

Abstract: **In this research, we are designing and manufacturing automated onion sorting system for that used belt conveyor system for conveying the onion. Also, we designed the belt conveyor system as per standard guidelines and references. It should also be used in any fruit sorting machine-like tomato, potato, mango and etc. in this paper we studied the belt conveyor system, theoretical calculations, designing in CATIA v5, manufacturing, testing, and last modification of the system.**

Keywords: *design, Catia v5, belt conveyor, manufacturing*

I INTRODUCTION

Conveyors (conveying equipment) are a group of devices, with not lifting gear, used for moving loads in a horizontal or inclined direction along a fixed path in a continuous flow. The conveying equipment is mainly used for bulk loads. In addition, conveyors are also used as a processing line in production units, like the automobile industry and fruit processing unit.

The conveyor system has many types. The belt conveyor system is the type of conveyor system. Belt conveyor system consists of a conveyor belt as a carrying medium. There are two or more pulleys in a belt conveyor system, with an endless loop of carrying medium The conveyor belt that rotates about them. To forward the material on The Belt and to move it one or both pulleys are powered. In this drive, a pulley is powered and idler pulley is unpowered. Generally, material handling and bulk material handling area two types of industrial classes of Belt conveyors. An example of general material handling is moving boxes inside the factories. An example of bulk material handling is the transportation of large volumes of resources and agricultural material like grain, salt, coal, ore, sand, overburden, etc.

The system consists of Electric motor, conveyor system, Arduino kit/raspberry, Gas sensors to detect rotten onions, pneumatic Actuator, hopper, blower, belt & pulley, supporting frame. Hopper is used for collecting lots of onion and onion falls over a conveyor belt through a hopper. The conveyor belt is mounted on head & tail pulley. The head pulley is directly coupled to prime mover as electric motor and moves the belt from the head to tail pulley and loading of Onions is done through the Hopper when onions fall from Hopper to a conveyor belt; the onions are moves in one end to the other end. By using gas sensors the sensors will detect the smell or gases of rotten onions and with the help ofmicro-controllers send a command to pneumatic actuators, and they will actuate, flap out the rotten onions from the system.

II LITERATURE REVIEW

Seema s. Vanaman and Pravin A. Mane, was studied design, manufacturing, and analysis of belt conveyor system used for cooling of mold. In this paper, they introduced the design of the belt conveyor system, theoretical calculations as per their literature survey, and selection of standard components, and also manufactured the whole belt conveyor system. After manufacturing and installation, take trials. The first trial takes with no load on the conveyor system. And in the second trial applied load on system and analysis of the stages of the system. For analysis used the belt comp software and showed the output result.

III MATERIAL SELECTION

The basic concept of selection of material we realize that we are often restrained by choices we have already made. For example, if different parts have to interact then the material choice becomes limited. When we talk about choosing material for a component, we take into account many factors. This factor can be broken down into the area.

Material properties: — the expected level of performance from the fabric.

Material cost & availability:-

1. The material must be priced appropriately (not cheap but right)

2. The material must be available (better to have multiple sources)
Processing: — must consider how to make a part, for example
1. Machining
2. Welding
Environment condition:-
1. The effect the service environment has on the part.
2. The effect the part has on the environment.
3. The effect that processing has on the environment.
The effect of the environment is directly affected by material properties the above material properties the best material selection for supportive frame, structure, and another parameter, we select the material, mild steel for actual product manufacturing. It has a good strength and high shock absorption capacity also has other good properties. Hence, we select mild steel for the manufacturing of meshing drum and supportive frame.

IV DESIGN CALCULATIONS

1. Belt

Length = 1000 mm (1m)
Height=900mm
W=20kg
A= Lump size= 80 (ungraded)

- Step 1: Finalizing belt width (B) and final belt speed (a)

B= X × a + 200
= 2.5 × 80 + 200
= 400 mm
B= 400 mm, V = 0.015 m/s= 15 mm/s

- Step 2: Motor Selections

1) Resistance of belt or top run
Wo = FL [(Gg + Gb) cosδ + Gro] + H [Gg + Gb]
Where,
G= 2.4
F= 0.02
L= 60 m
Gb = Q / 3.6 V
Q= 744 TPH
V= 1.684 m/s
Gb= 9 kgf/m, ρ= 0o
Gro= Wr/s = 24.4/1.5
H = 900 mm = 0.9 m
Wo = 377.31 kgf

2) Resistance of bottom run
Wu = G‟ FL [4 b . cos ρ + Gxi] . µ . Gb
G‟ = 2.4
F = 0.02
L = 1 m

3) Total Resistance = Wo+ Wu
= 3847.4 N

4) Selection of motor

$$m.p. = \frac{P.V.}{\eta_{mech}} \times K_{abh}$$

m.p. = 8.14kw
8.14 is not available
So select 7.5kw motor

With 960rpm……N_{Actual}
1000rpm……$N_{theorotical}$

- Step 3: Belt cross-section

1) Max. Tension (T1)

$$T1= P\times [\frac{e^{\mu x}}{e^{\mu x-1}}]$$

Where,
P=Resistance
$\mu = 0.25$
x= 4.14 rad
T1 = 5926.49N

2) Number of plies in belt (i)

$$i=\frac{Ti}{BF} = \frac{5926.49}{400\times 0.82}$$

i(a)= 2 plies

3) Belt cross section
t= 7mm
B= 400mm

4) Stress Induced: (б f)

$$бf= \frac{\pi}{B\times t} + \frac{E.t.}{D}$$

D= K1×K2×i
= 1.25 × 50 ×2
= 125 mm
Where, T1 = maximum tension
B= width
t= thickness
E= 100N/mm2 (modules)
б= 7.7N/mm2

- Step 4: Design of drum shaft and selection of drum shaft bearing.

1) Drum design (Drag)
W= B + (2× Edge clearance)
= 400 + (2 ×50)
= 500mm

2) Design of drum shaft
T2= T1- P
= 2079.09
Wps= T1+ T2
= 5926.49 + 2079.09
= 8005.58

$$\frac{Wps}{2} = 4002.79$$

3)Bending moment

$$M= \frac{Wps\times L}{4}$$

$$= \frac{8005.58\times 520}{4}$$

M= 1.0407× 106N/mm

4) Torque

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

$$V= \frac{\pi DN}{60}$$

$$0.015= \frac{\pi\times 0.125x}{60}$$

N= 2.29rpm
T= 31274.989
T= 31.247 × 103 N/mm

Equivalent torque (Te)

$$Te= \sqrt{(kb \times m)^2}$$

Te= 2.0819 × 106 N.mm

Shaft Diameter

$Te = \frac{\pi}{16}(\tau) \times (ds)^3$

$\sigma_{st} = 360$

$\sigma_{ut} = 670$

$\tau = 0.3sut$

$= 0.18sut$

$\tau = 108 N/mm^2$

τ with key=0.75(τ)=81 N/mm2

$ds = 50.77mm = 50mm$

5) Drum shaft bearing

Ft =4002.79

F0= 0

Life= 25000 hrs

$Lmr = \frac{N \times 60 \times Ln}{10^6}$

$= \frac{2.96 \times 60 \times 25000}{10^6} = 4.44mm$

Equivalent load= Peff× (V. Fr. + y.fa) 5.1

= 4002.4 × 1.3

= 5203.132 N

= 5.203 kN

C= 40× Pe

= 4.44 × 5.20

= 8557.67 N

Select bearing = 22104

D = 50, select = 2210 bearing

- Step 5: Rollers and Idlers

  DO= 50mm

  Di = 50- 2+ 6

  = 28 MM

  Bearing = 6310

  L= 500 mm

- Step 6: Gear box:

$IOA = \frac{Ni/p}{NO/p} = \frac{960}{2.96} = 324.32$

IOA = 324.32

Select 2 or 3 stage reduction Gearbox

V CATIA MODEL

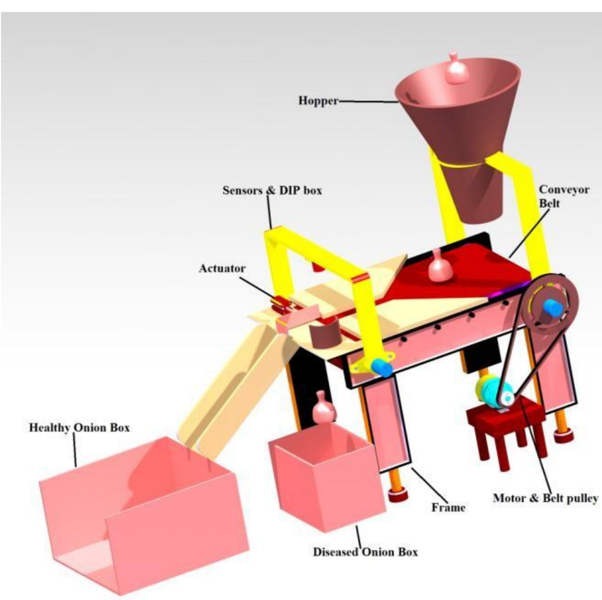

Figure 1 Catia Model

IV CONCLUSION

The aim of the project was to design and developed a conveyor system for the „Smart Onion Sorting Machine" to carry lots of onion. We designed the conveyor system with standard procedure according to the PSG data book and it meets or surpasses all the requirements of the systems.

NOMENCLATURE

Symbol	Description
C	Belt Capacity
V	Belt Speed
L	Length of Conveyor
H	Height of Conveyor
W	Total weight of the conveyor
Wm	Weight of Material per unit run
Wb	Weight of Belt per unit run
Te	Effective belt tension
Si	Idler spacing
P	Power
Mt	Torsional moment
Mb	Bending Moment
D	Diameter of pulley
F	External force
G	Gravitational acceleration
N	Speed of motor
D	Diameter of shaft
T	Shear stress
σut	Ultimate tensile strength
σyt	Yield strength
I	Moment of Inertia
δmax	Maximum deflection
бb	Bending stress
K	Radius of gyration
T	Thickness of channel

REFERENCES

[1] Seema S. Vanamane and Pravin A. Mane, "Design, Manufacture, and Analysis of Belt Conveyor System used for Cooling of Mould", International Journal of Engineering Research and Applications (IJERA) Vol. 2, Issue 3, May-Jun 2012, pp.2162-2167

[2] Smita Shelke, Prof. A. P. Phatale, "An Automatic Grading System Based On Machine Vision", International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering Vol. 1, Issue 4, July 2013

[3] V.B. Bhandari, "Design of Machine Elements", Third edition, The Mcgraw-hill Companies

[4] PSG data book

BIOGRAPHY

Pagar Vicky Madhavrao holds a BE (in Mechanical Engineering) from Savitribai Phule Pune University.