Design of Multipurpose Grating Machine

Shubham Nasare[1], Ritesh Chimankar[2], Bhupesh Sarode[3]
[1,2] *Department of Mechanical Engineering, K.D.K. COLLEGE OF ENGINEERING, NAGPUR*
[3] *Prof. Department of Mechanical Engineering, K.D.K. COLLEGE OF ENGINEERING, NAGPUR*

***Abstract*- A grating machine is for grating the various vegetables and fruits in it. It is an much faster method than the available methods in India. The main target of machine is to perform grating operation for the variety of products but in more safer way. The aim is to produce a machine that can be easily operable by most of the people. The objective of this grating machine is that it could help society in better way by reducing time and by making it safer. This machine is produced to reduce the human effort. Objective of study is to design and fabricate grating machine affordable for small scale industry.**

INTRODUCTION

Grated fruits and vegetables are used in varies activities, so it need to be produced. There has been a traditional way of grating fruits using blades or manual grating tool, so it need to be improved as it needs more time and human effort. Using this creative design for the machine the job can be completed in lesser time. It can be use for grating at cheaper rate which can be affordable for maximum people. It is useful for producing more grated powder by selecting number of fruit or vegetables at single time. It can be useful for higher production rate; it consumes much lesser power for grating. These machines have multifunctional capabilities, by changing the type of sieve type of grated product can be change. If there is an requirement of chips of fruits by changing the Type of sieve it can give desired results. In this way by changing the sieves of different pattern desired product can be changed. Hence it can be useful for production purpose; it can be beneficial for small scale production.

LITERATURE REVIEW

There are various methods of grating, which are not useful for variety of materials, also they are time consuming and less safe. The surveying of literature regarding this ecosystem is listed below.

Sajil Raj PR, Anshodh A, Samuel BT Raj, Ahsana AN designed a machine for coconut grating, it is very compact design as comparing with other grating machines but it needs many components for the working and it needs human interaction to move the movers towards coconut, hence it is less safer method for grating.

Dharwa chaitanya kirti Kumar (2) developed and designed a multipurpose machine, this machine is powered by human force, and its gear drive runs using human force. Using some attachment it can totally work using electricity.

DESIGN PROCEDURE

The following are the calculations for Design of V-Belt

D1= 101.6mm
D2= 203.2mm
PR= 1HP

1. DESIGN POWER

PD= PR×Kl
PD=0.746×1.1
PD=0.8206 KW

SECTIONS OF BELT

As per suggested range of power we select 'A' section belt
Width=w=13mm
Thickness=8mm
Dmin=75mm
Kc=2.52
Kb=17.6×10000

2. DIAMETER OF PULLEYS

D1=101.6mm, D2=203.2mm
As D1>Dmin
Hence design is safe

3. CHECK VELOCITY

$Vp=\pi D1N1$
Vp= 478.7787 m/min
Vp=7.979 m/sec
Hence Vp is in range that is 300-1500m/min
Hence design is safe

4. CENTRE DISTANCE
C=D1+D2
C=101.6+203.2
C=304.9=305mm

5. ANGLE OF LAP
θ 1=π- D2-D1/C
θ 1= 2.808
θ 2= π+ D2-D1/C
θ 2= 3.4749

6. COEFFICIENT OF FRICTION
μ =0.3

7. BELT TENSION RATIO
Assume α=28
F1/F2 =13.296 (for θ 1)
F1/F2= 24.58 (for θ 2)
Select lower value
F1/F2 =13.296

8. POWER RATING PER BELT
$=(Fw-Fc)\times e^{\mu\theta/\sin(\alpha/2)}-1/e^{\mu\theta/\sin(\alpha/2)}\times Vp$
$Fc=kc\times(Vp/5)^2$
Fc=4.617N
$Fw=w^2=169$
Power Rating/Belt = 1199.68W

9. NUMBER OF BELT REQUIRED
Number of belt = Pd/power rating per belt =820.6/1199.68
Number of belt required= 0.684= 1

10. LENGTH OF BELT
$L= \pi\backslash 2\times(D1+D2)+2C+(D2-D1)^2/4C$
L=1097mm=1.097m
Assume negligible slip
D1N1=D2N2
N2=750rpm

Following are the calculations for Design of shaft
PR= 1HP

1. DESIGN POWER
Pd= PR×Kl
Pd= 0.8206KW

2. DESIGN TORQUE
$Td= Pd\times 60/2\pi N2$
$Td= 10.448\times 10^3$ N-mm

3. Shear stress in shaft
$=Td/Zp=53211.227/ds^3$
Assume shaft material as SAE1030
Syt=296MPa
Assume FOS = 6

4. Permissible shear stress
= 24.667MPa
ds= 12.92098mm
Increases shaft diameter by 50% due to bending load
ds= 12.92098×1.5
ds= 19.38947mm
As standard diameter for shaft is 25mm
ds= 25mm

Following are the calculations for Design of Pulley
1. TYPE OF CONSTRUCTION
Diameter of pulley = D2=203.2mm
Width of pulley = w= 1.1b
Width of belt=b= 13mm
W=1.1×13= 14.3mm
As D2>105mm and W is upto 300mm
Arm construction is selected
Number of arms= n= 4
Number of sets= 1

2. DESIGN OF KEY
For shaft diameter, ds =25mm
Key crosssection
b =8mm
h= 7mm
Length of key =L= 18 to 90mm

3. Design of Hub
Hub Diameter=Dh= 1.5ds+25mm
Dh=62.5mm
Length of hub= Lh= 1.5ds
Lh= 37.5mm

4. DESIGN OF ARM

Moment on each arm= (F1-F2) × (D2-Dh)/Number of arms
$M=3.617\times10^3$ N-mm
Bending stress in arm= M/Z
Select elliptical cross section of arm
Assume allowable bending stress in arms
Бb=15MPa
As allowable stress= M/Z
h=17mm
Space available on hub=πDh= π×62.5= 196.349mm
Space required for accommodation of 4 arms
=4×h= 4×17= 68mm
Space available > Space required
Arms can be accommodated on hub

5. DESIGN OF RIM

Rim Thickness= t= $0.25\times (D2)^{1/2}+1.5$
t=5.0637mm
As C= 1mm in 100mm face width of pulley
As W= 14.3mm
We required c= 0.143mm.

WORKING PROCEDURE

- Choose the appropriate size of sieve of desired hole size.
- Fix the sieve on cylindrical type drum which is mounted on shaft
- Plug the machine, when we switch on the machine the motor at bottom starts rotating and thus the shaft rotates which is connected to motor via pulley and V-Belt
- Put the grating material in the hopper, press the grating material against the rotating drum by using wooden rod
- Press the grating material till the whole material grates
- Grated material is collected in collecting pan
- And use it for required purpose

ADVANTAGES

- Safer for the operator.
- Easy to setup anywhere.
- Simple in construction.
- Easy to operate.
- Useful for multiple fruits and vegetables

CONCLUSION

- While designing a machine cost is an major issue to deal and this machine can come over it, this multipurpose grating machine have safer design, it consumes less time and it is really cost effective. It can grate fruits and vegetables in very short time and produced quality is also very good. While manufacturing the machine the components are easily available and the machine does not need any special component. As of design it can be easily manufactured within less time period and thus due to low cost it can be beneficial for the consumers. There is no specialized skill required to run the machine. It can be very useful for those who want to start an startup within limited budget.

REFERENCES

[1] Sajil Raj PR, Anshodh A, Samuel BT Raj, Ahsana AN,"Design of an Innovative Coconut Grating Machine Using Tinkercad", International Journal of Research In Mechanical Engineering Volume 4, Issue 3, 2016, pp. 178-182
[2] Dharwa Chaitanya kirti kumar," A Research on Multipurpose Machine", International Journal for Technology Research In Engineering,1(1),2013,16-18
[3] Hetzler, A. A.review space of nutrition education for prescholar , TOPICS IN CLINICAL NUTRITION. 1990:5:35-46
[4] MOTT, D, CRIAG, C,Home appliance study in :agood housekeeping consumer dept.,New York 1982
[5] Baker, S.P.,O'Neill ,B,Karph R.S.
[6] A textbook of "MACHINE DESIGN" by R.S. KHURMI & J.K. GUPTA
[7] A design databook by B.D. SHIWALKAR
[8] "MACHINES & MECHANISMS" by uicket, pennock & shigley, third edition. Oxford, 2002