



DESIGN AND CONSTRUCTION OF A YOUNG COCONUT PEELING MACHINE WITH A CAPACITY OF 60 FRUITS/HOUR FOR MICRO-ENTERPRISES

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Abstract

This study aims to analyze the Power motor Which needed For peeling skin coconut young ; Basics Which used For make machine peeler skin young coconut ; Calculation components construction machine peeler young coconut skin ; Time Which needed in One time peeling skin coconut young in manual ; Results Which obtained from testing tool help peeler or cutter coconut skin young. From the results of the discussion in designing the construction of a young coconut peeling machine with a capacity of 60 pieces / hour with acceptable results according to the plan. After the discussion is carried out in accordance with what is desired based on the objectives of this planning, namely: determining the motor power needed to drive the young coconut peeling machine; determining the material and size of the machine elements used; showing the work of the machine and making a working drawing of the coconut peeling machine. The results can be concluded as follows: The electric motor used = 1 hp , Belt length on the pulley = 61 inches , Motor pulley diameter = 3 inches , Pulley diameter on the coconut drive = 12 inches , Bearing = 6205 , Analysis of the cost of making the machine used Rp: 5,602,000 .

1. INTRODUCTION

Developments in the field of technology, especially in the machining sector, are very rapid, especially in the manufacturing industry. In this era of globalization, with the current developments in technology, humans will strive to create the latest innovations to make more human work efficient, can be used by many people, especially micro-business actors.

In today's life, there are many tools used in peeling or cutting coconuts. made For make it easier work man in do peeling or cutting tools, for example knives, machetes and others. But in the current era of globalization, this has not been Many tools are found that are used to peel or cut the skin of young coconuts. which can served direct . On planning This designed tool help For peeling or cutting young coconut skin. This tool was created to



shorten processing time and improve the final result, speeding up the process and producing more products. more neat to fruit coconut young, as well as seller No need have special skills in holding a weapon (cutting tool) to peel or cut skin coconut young.

For this reason, a machine was designed that can help peel coconut skin. young with more fast , Where this machine works by relying on the fast rotation of the machine Which later can increase the efficiency of peeling young coconut skin, both in terms of speed, power, amount production, until factor security machine the peeler. So that need buyer fulfilled with more fast And increase the attraction when served, so from That we choosing the title "Design and Construction of a Young Coconut Peeling Machine with a Capacity of 60 pieces/hour for Micro Business Actors" to be material For task end Which we arrange as Wrong One condition finish education S1 at the Faculty of Engineering, Darma Agung University

Based on the above problems, we took the initiative to choose Title: " **Design and Construction of a Young Coconut Peeling Machine with a Capacity of 60 Fruits/Hour for Perpetrator business Micro** "

1.1 Formulation Problem

From background behind above can taken a number of problem that is :

1. Power motor Which needed For peeling skin coconut young.
2. The Basics Which used For make machine peeler skin young coconut.
3. Calculation components construction machine peeler young coconut skin.
4. Time Which needed in One time peeling skin coconut young in manual.
5. Results Which obtained from testing tool help peeler orcutter coconut skin young.

1.2 Objectives Design Get up

Objective design get up this is :

1. Make machine peeler skin coconut young For help manpower.
2. For produce results production Which more And more Good.
3. For increase time process production faster and the shape of the fruit is uniform

1.3 Benefits Design

Benefit from manufacturing design get up machine peeler automatic skin young coconut this is :

1. Make it easier in system peeling skin coconut young for Seller coconut young. Adds attractiveness to buyers in terms of the shape of the peeled coconut increase level security on moment peeling

2. LITERATURE REVIEW

2.1 Motorbike

2.1.1 Determining the motor

To move the entire young coconut peeling machine device, you need to know the power of the driving motor required to be able to move all the components/tools. To determine the motor power, the formula used is:

$$P_1 = I \cdot \alpha \cdot \omega$$

Where :

P_1 = required driving motor power (KW)

I = moment of inertia (Kg. mm²)

α = angular acceleration (rad/ S²)

ω = angular velocity (rad/ S)

2.1.2 power planning

$$p_2 = T \cdot \omega \text{ (e.sighley ,1986)}$$

Where :

p_2 = driving power only load (Kw)

T = Torque caused by load (kg. m^2)

$T = Fr$

F = force on stripping (kg)

$$F = \frac{m.v}{r}$$

m = mass of coconut fiber to be sliced

r = the furthest distance of the load from the axle shaft

v = angular velocity = $\frac{2.\pi.n}{60}$

n = stripping rounds

2.1.3 power required :

$$\text{Total Pt} = P_1 + P_2$$

2.1.4 motor driving power

$$P = P_{\text{total}} . fc$$

2.2 Axis

2.2.1 Transmitted power and planning power

$$p_d = P \times fc(\text{kw})$$

Where :

p_d = planned power (kw)

fc = correction factor

P = power

2.2.2 Determine the twisting moment or torque that occurs

The magnitude of the torque that occurs (T) on the shaft is:

$$T = 9,74 \times 10^5 \cdot \frac{Pd}{n_1} \quad (\text{Sularso, 1997:7})$$

Where :

T = torsional moment (kg.mm)

n = rotation (rpm)

Pd = design power

2.2.3 Determining the permissible shear stress (τ_a) of the shaft material is:

$$\tau_a = \frac{\sigma_B}{Sf_1 . Sf_2} \dots \dots \dots (\text{Sularso, 1997: 8})$$

Where :

τ_a = Allowable shear stress (kg/mm²)

σ_B = Tensile strength (kg/mm²)

Sf₁ = material safety factor

Sf₂ = safety factor of keyed material

2.2.4 Calculating the permissible shaft diameter

$$ds = \left[\frac{5,1}{\tau_a} Kt . Cb . T \right]^{1/3} \quad (\text{Sularso, 1997: 8})$$

Where :

ds = Shaft diameter (mm)

τ_a = Allowable shear stress (kg/mm²) Kt = Impact correction factor

Cb = Bending correction factor

T = Design moment (kg.mm)

2.2.5 Determine the torsion angle check that occurs

If ds (mm) is the shaft diameter, l (mm) is the shaft length and τ (kg, mm^2) is the shear modulus, then the torsional deflection θ is

$$\theta = 584 \cdot \frac{Tl}{Gd_s^4} \text{ (Sularso, 1997:18)}$$

Where :

θ = Deflection angle

T = Torque (kg.mm)

ds = Shaft diameter (mm)

G = Shear modulus, for steel =

8.3×10^3 (kg/ mm^2)

L = shaft length

2.2.6 Determine the shear stress that occurs on the shaft:

$$\tau = \frac{5.1.T}{ds^3} \text{ (Sularso, 1997:7)}$$

2.3 Stake

2.3.1 Determine the tangential force acting on the surface of the key

$$f = \frac{T}{ds/2} \text{ (kg) (Sularso, 1997:25)}$$

Where:

F = Tangential force (kg)

T = Design torque (kg.mm)

Ds = Shaft Diameter

2.3.2 required length of the dowel (l) :

$$l, \geq \frac{F}{b \cdot \tau k a} \text{ (mm) (Sularso, 1997:25)}$$

Where :

l = Length of dowel (mm)

F = Tangential force of the pin (kg)

b = Width of the dowel (mm)

2.3.3 Determining the allowable shear stress τg on the key

$$\tau g = \frac{\sigma b}{sf1 \cdot xsf2} \text{ (Sularso 1997: 8)}$$

Where :

σb = strength of the axle material tank

Sf1 = material safety factor

Sf2 = safety factor of keyed shaft

2.3.4 Determine the shear stress τk that occurs in the key:

$$\tau k = \frac{F}{b \cdot l} \text{ (kg/mm}^2\text{) (Sularso, 1997:25)}$$

2.4 Belt

2.4.1 Axial spacing

$$C = \frac{b + \sqrt{b^2 - 8(Dp - dp)^2}}{8} \text{ (Sularso, 1997:170)}$$

Where :

L = circumference of the belt (mm)

C = pulley axle distance (mm)

Dp = large pulley diameter (mm)

dp = small pulley diameter (mm)

b = $2.L - \pi(Dp + dp)$

2.4.2 Linear velocity of the belt,

$$V = \frac{\pi \cdot dp \cdot n}{60 \cdot 1000} \quad (\text{Sularso, 1997:166})$$

Where :

dp = diameter of the drive pulley (inches)

n = motor rotation (rpm)

2.4.3 Transmission comparison,

$$\frac{n_1}{n_2} = \frac{Dp}{dp} \rightarrow n_1 n_2 = Dp : dp \dots \dots \quad (\text{Sularso, 199:166})$$

$$n_1 dp = n_2 Dp$$

Where :

n_1 = Drive rotation (rpm)

n_2 = Driven rotation (rpm)

Dp = large pulley diameter (mm)

dp = small pulley diameter (mm)

2.4.4 Belt circumference (L)

The length of the belt can be found using the following equation:

$$L = 2C + \frac{\pi(dp + Dp)}{2} + \frac{(Dp - dp)^2}{4c} \quad (\text{Sularso, 1997:170})$$

Where :

L = circumference of the belt (mm)

C = pulley axle distance (mm)

Dp = large pulley diameter (mm)

dp = small pulley diameter (mm)

2.5 Contact angle

Belt contact angle with drive pulley

$$\theta = 180^\circ \frac{57(Dp - dp)}{c} \quad (\text{Sularso, 1997:173})$$

2.6 Belt tension

Effective tensile force (Fe)

$$Fe = T_1 - T_2 \quad (\text{Sularso, 1997:171})$$

$$Fe = \frac{102 \cdot P}{v} \quad (\text{Sularso, 1997:171})$$

Where :

v = linear velocity of the belt (m/s)

P = power transmitted by the drive pulley (kw)

Voltage

$$\frac{T_1}{T_2} = e^{\mu \cdot \theta} \dots \dots \quad (\text{Sularso, 1997:171}) \text{ Where:}$$

T1 = belt tension (kg)

T2 = slack side tension of the belt (kg)

e = base number of Naviar logarithm = 2.71282

μ = coefficient of friction between the belt and the pulley 0.45 to

3. IMPLEMENTATION METHOD

The design method is carried out using an approach to micro-business actors/communities and a structural approach.

The approach to micro-business actors is carried out to survey the field to obtain the data needed before carrying out the design, while the structural approach is carried out by designing the design and calculating several main components of the machine.

Information:

1. Lower frame
2. Upper frame
3. Coconut drive shaft

4. Drive shaft pulley
5. Drive motor pulley
6. Bearings
7. Electric motor
8. Belt
9. Side paring knife
10. Paring knife slide
11. Upper knife house
12. Coconut lock
13. Coconut lock safety
14. Nuts and bolts
15. Coconut shaft push pedal

4. RESULTS AND DISCUSSION

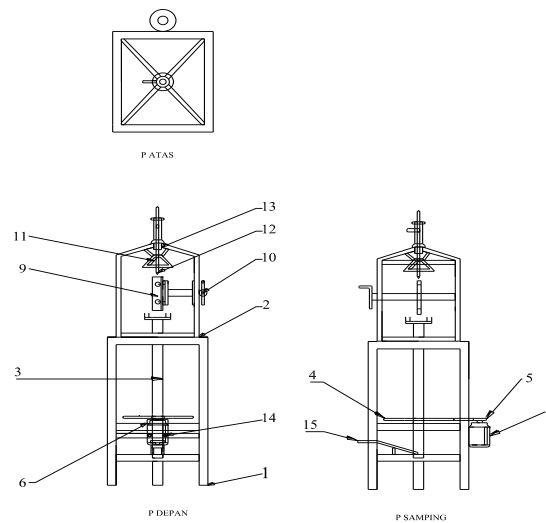
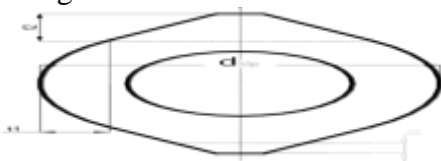


Figure 4.1 projection of young coconut peeling machine

(Source: personal document)

4.1 Blade rotation requirement (n):

- a. The thickness of the peeled coconut fiber is assumed to be:
 $2(t_1) + t_2 = 2(24) + 35 = 83$ millimeters, with a feeding thickness for each round of 1 millimeter, an illustration of the thickness of the coconut fiber to be peeled is shown in Figure



(a) coconut before peeling;

(Source: IST AKPRIND Yogyakarta)



(b) results of peeled coconut

(Source: personal document)

b. So to peel one coconut it takes several turns.

as many as:

$$n = \frac{143}{1} = 143 \text{ rounds}$$

c. From the analysis above, the number of rotations required to peel one coconut is 143 rotations. In one hour the machine must be able to peel 60 coconuts, meaning the pulley must rotate $60 \times 143 = 8580$ rotations, it can be ascertained that it is impossible for all the pulley rotations to work peeling coconuts. It can also be ascertained that the rotations lost during peeling and the rotations lost during the process of exchanging the work of the blade so that this easy coconut peeling machine can be assumed to have an efficiency of 44% or 0.44, then the rotation is $8580 : 0.44 = 19500$

: So for every hour it takes 19,500 turns, so in one minute the number of turns is:

$$\frac{19500}{60} = 325 \text{ rev/min}$$

$$n_2 = 325 \text{ rpm}$$

4.2 Calculation of core components in the machine

1 Coconut seat axis calculation

a. processing power

$$P = 1 \text{ hp}$$

$$P = 1 \times 0.735 \text{ kW}$$

$$P = 0.735 \text{ kW}$$

b. torsional moment/torque

$$T = 9,74 \times 10^5 \cdot \frac{Pd}{n_1} \dots$$

$$T = 9,74 \times 10^5 \cdot \frac{0,735}{1400}$$

$$T = 511.35 \text{ (kg.mm)}$$

c. diameter of the coconut rotating shaft

$$K_t = 1.5$$

$$C_b = 2$$

$$d_s = \left[\frac{5,1}{\tau_a} K_t C_b T \right]^{1/3}$$

$$d_s = \left[\frac{5,1}{4,42} 1,5 \cdot 2 \cdot 511,35 \right]^{1/3}$$

$$d_s = 12 \text{ (mm)}$$

The minimum shaft requirement is 12 mm, for this planning the shaft used is 25 mm so that it is safe to use.

2. Determine the material, size and strength of the dowel

1. Peg material

The dowel material is determined from S30C machine construction carbon steel with tensile strength = 48 kg/mm^2

a. Tangential force of the key

$$F = \frac{T}{d_s/2}$$

$$\text{Then: } F = \frac{511,35}{25/2}$$

$$F = 40.9 \text{ (kg)}$$

b. Determine the shear stress that occurs on the pin

$$\tau_k = \frac{F}{b.l}$$

$$\text{So } \tau_k = \frac{40,9}{3 \cdot 25}$$

$$\tau_k = 0.54 \text{ (kg/mm}^2\text{)}$$

The shear stress that occurs on the dowel is 0.54 (kg/mm²)

c. Determining the allowable shear stress

(τ_{ka}) on the peg

$$\tau_{ka} = \frac{\sigma b}{sf_1 \times sf_2}$$

$$\text{Then } : \tau_{ka} = \frac{48}{6 \cdot 2}$$

$$\tau_{ka} = 4 \text{ (kg/mm}^2\text{)}$$

d. determine the length of the required peg l

$$l \geq \frac{T}{b \cdot \tau_{ka}} \text{ (mm)}$$

$$\text{So } : l \geq \frac{40,9}{3 \cdot 4}$$

$$l = 3.4 \text{ mm}$$

Meanwhile, the specified peg length is 25 mm so

$l = 3.4 \text{ (mm)} < 25 \text{ (mm)}$. then the peg is said to be safe.

3 Determining the pulley on the coconut drive shaft is easy

D_p = diameter of the coconut drive shaft pulley

D_p = diameter of motor drive pulley = 3 in (76 mm)

n_1 = motor pulley rotation 1400 rpm

n_2 = rotation of the coconut rotating pulley 325 rpm

so :

$$\frac{n_1}{n_2} = \frac{D_p}{d_p}$$

$$= \frac{3 \times 1400}{325} = 12.92 \text{ in}$$

$$D_p = 12 \text{ inches (304 mm)}$$

4. Coconut rotating pulley belt

a. Distance between the pulley axles

$$C = 1.5 \times D_p$$

$$= 1.5 \times 304$$

$$C = 456 \text{ (mm)}$$

b. Belt length

$$L = 2C + \frac{\pi}{2} (d_p + D_p) + \frac{1}{4C} (D_p - d_p)^2$$

$$L = 2 \times 456 + \frac{3,14}{2} (76 + 304) + \frac{1}{4 \times 456} (304 - 76)^2$$

$$= 912 + 596,6 + (28)$$

$$L = 1536,6 \text{ (mm)}$$

C. The distance between the axle shafts used

$$b = 2L - \pi (D_p + d_p)$$

$$b = 2 \times 1549 - 3.14(304 + 76)$$

$$b = 3098 - 1193$$

$$b = 1905 \text{ (mm)}$$

So the distance between the axles that will be made is:

$$C = \frac{b + \sqrt{b^2 - 8(D_p - d_p)}}{8}$$

$$C = \frac{1905 + \sqrt{1905^2 - 8(304 - 76)^2}}{8}$$

$$C = \frac{1905 + 1792,52}{8}$$

$$C = 462 \text{ (mm)}$$

d. The magnitude of the contact angle that occurs

$$\theta = 180^\circ - \frac{57(D_p - d_p)}{c}$$

$$\theta = 180^\circ - \frac{57(304 - 76)}{462}$$

$$\theta = 180^\circ - 31.33^\circ$$

$$\theta = 148^\circ$$

$$\theta = 148 \times \frac{\pi}{180}$$

$$\theta = 2.5 \text{ rad}$$

e. Bearings

- Two bearings are used with the same specifications.
- Bearings used Bearing No. = 6205
- The bearing used has an inner diameter of 1 inch = 25 mm

5. CONCLUSION

From the results of the discussion in designing the construction of a young coconut peeling machine with a capacity of 60 pieces / hour with acceptable results according to the plan. After the discussion is carried out in accordance with what is desired based on the objectives of this planning, namely: determining the motor power needed to drive the young coconut peeling machine; determining the material and size of the machine elements used; showing the work of the machine and making a working drawing of the coconut peeling machine. The results can be concluded as follows:

- Electric motor used = 1 hp
- Belt length on pulley = 61 inches
- Motor pulley diameter = 3 inches
- Pulley diameter on coconut drive = 12 inches
- Bearing = 6205

Analysis of the manufacturing costs of the machine used Rp: 5,602,000

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Friendly Young Coconut Peeler