Developing Design Cracker Anacardium occidentale (mente) for Home Industrial

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Abstract: These purpose of my research was to design the peeled of cutting and made its quality and quantity of the cracker mente. The method for evaluation was designing and testing several peel models, testing crack effectively, and testing for its quality and quantity cracker. With developing design cracker mente, we found the cracker home industrial. The cracker mente have developed design a cutting knife with follow the mente’s the top of the ellipse knife. The length effectively was the maximum produce cracker quality is 8 mm with width mente average 25-27 mm. The result of the design knife for cracker mente has to be grade mente quality to produce to be 79,25% each 1 kg with time peeling take 26 menit, 55 detik.
Kata kunci: Peeling mente.

I. Introduction
Mente is one of planted that has a high economic value at the national, and international market. Commodity horticulture at South Celebes enough much. Data from The Center of Statistic (CS) extension areal horticulture mente at South Celebes are 66.167.05 Ha, the total production reaching 23.369.92 tons. The regions that produce mente the great at South Celebes are Bone, Sidrap Pangkep, Barru, Sinjai, Bulukumba, and Selayar.

Agribusiness mente at South Celebes id makerting and preparation. For marketing at South Celebes could be to buy for its company. The farmer bargaining position with its value and have a profit for its working. Where the company efforted grade value for the farmer. Mente price is Rp. 5500/kg and grade mente is Rp. 45.000,-/kg overflow 100 kg mente produce 20 kg grade mete. So that efforted to be grade mente kernel we have income up than 50 %.

Processing cracker mente by company in scale home industrial at South Celebes commonly used tools kacip mente. The tool worked to put a knife up the mente and press down, so that the rind was peeled. And then split the mente, but the tool did not have a transform point at the center so that when spilt the mente seldom took off. After observation from the workers of the mete at region Barru got information total average mente that can be split in a day are 5—6 kg. Rismunandar (1986), capacity production mente used the tool kacip mente with power workers are 5—8 kg/day.

Capacity product information can find 50% mente good and 50% other ugly. And the good mente are very different with ugly mete. By survey at Supermarket Alfa Tamalanrea the price of ugly mete are Rp 58.000/kg, and the good mente are Rp 61.875/kg.

Azis (2008) has design the spilt of mente with transform system. These tool has grade its capacity production in 1 kg at 1 jam and prosentase good mente was 74,45%. Less of the tool was limited of the knife so that the small mente cannot split well.

For finding quality design kacip mete, indeed the knowledge about the engine must be notice all aspect of-kacip mente design.

 Forces at kacip mente among other things were:

➢ Massa tool components Kacip Mente

Relation with massa, volume and specific weight can be formula as the next:

\[ W_t = V \times p \]

Explanation:

\( W_t \) = massa tool component kacip mete (kg)
\( V \) = Volume component (mm³)
\( p \) = specific weight steel.

➢ Forces Stick Press

(Khurmi 1985) to know how many transform forces stick press can be used formula as the next:

\[ F = 2a \times \frac{F_y}{dc} \]

Explanation:

\( F \) = Forces load from experiment mente (N)
\( F_y \) = Force transform axle press (N)
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a = length transform arm/ axle press (m)
dc = Diameter Cam (mm)

➢ Force effort endurance by axle press (Khurmi 1985) formula for force can be efforded by axe press is :

\[
F = \frac{\pi^2 E I}{4V(2l)^2}
\]

Explanation:
F = Force effort load endurance by press axle (kg)
E = modulus elastic (N/mm²)
I = moment inertia (mm⁴), \( I = \pi d^4/64 \)
V = coeisien pengaman.

➢ Calculation Bench Strength
For calculation bench strength can used formula as the next :

\[
\sigma_t = \frac{F}{A} \quad A = px l
\]

Explanation:
\( \sigma_t \) = tension pull bench (N/mm²)
F = force at the bench (N)
A = surface bench (mm²)
p = length bench (mm)
l = width bench (mm)

➢ Work for acting press
Formula for work is :

\[
W = F_p x a
\]

Explanation :
W = Work (joule)
\( F_p \) = force stick move press (N)
a = length arm stick (m)

➢ Power can be found by the tool press is :

\[
P = \frac{W}{t}
\]

Explanation :
P = Power tool press (Watt)
W = Work (joule)
t = time for pressing (second)

➢ Bolt Axle Press
For calculating bolt axle press used formula :

\[
\sigma_t = \frac{F}{A} \quad A = \pi d_i^2/4
\]

Explanation:
\( \sigma_t \) = tension pull/bolt (N/mm²)
F = force work at the bolt (N)
A = surface bolt (mm²)
d_i = diameter center/critis bolt (mm)

➢ Press Plat
For appointment central as the next :
Gambar 2.2. Press Plat

Explanation:

Cg = central gravity
X = distance central to horizontal edge
y = distance central to vertical edge

Strength setting weld plat

For calculating weld strength used formula:

\[ \sigma_t = \frac{F}{A} \times l_a \]

Explanation:

\( \sigma_t \) = tension pull/press occur (N/mm²)

l = length the weld (mm)

a = thick plat (mm)

\( l_a \) = length efektively (mm) \( (ln = l - 2a) \)

Load and Tension Move Spiral

For calculating spiral used formula as the next:

\[ C = \frac{D}{d} \]

Explanation:

C = index spiral

D = diameter average wrap spiral (mm)

d = diameter wire spiral (mm)

\[ K = \frac{4c - 1}{4C - 4} + \frac{0.615}{C} \]

Explanation:

K = Factor tension from Wahl (number Wahl)

\[ \delta = \frac{8WD^3n}{Gd^4} \]

Explanation:

\( W \) = load (N)

\( G \) = Modulus move

N = total wrap spiral

n = total actively wrap

\[ T_g = \frac{8WC}{\pi d^2} \]

Explanation:

\( T_g \) = tension move (N/mm²)

Bench

For counting the bench moment needed to know bent moment, bent tension and tension maximum, (Khurmi 1985) endurance bent moment and maximum tension can used formula as the next:

\[ W_b = \frac{bh^2}{6} \]

Explanation:

\( W_b \) = moment bent endurance (mm³)

b = length bench (mm)

h = width bench (mm)

\[ \tau_{\text{max}} = \frac{M_{\text{max}}}{W_b} \]

Explanation:

\( \tau_{\text{max}} \) = tension bent maximum (N/mm²)

\( M_{\text{max}} \) = moment bent maximum (N/mm), can be found from analysis forces was worked again the bench with Free Body Diagram.
II. Method Research

This research was conducted at the workshop mechanical engineering Universitas Negeri Makassar with in research for 6 months. The tools this research used were saw machine, frais machine, lathe machine, weld machine, sney, tapped, screw-driver, tools, weight, and stopwatch. Materials the research used are steel plat, galvanis pipe, axle, stainless-steel knife, plat strep, nut, and bolt. The prototype peel machine as the shown picture 2.1.

III. Result And Discussion

3.3 Result

A. Calculation Result Hasil

Jackson

a. Force occur at the knife

Mente can be peeled if found press force/ loaded. The load was press force from stick press, axle press, arm and knife can be calculated with data meanwhile;

Dimension of mente : length x width x high = 35x17x25 mm

Experiment press of mente got force for peeling mente is 500 N and length of the knife = 55 mm.

F : a – R_B, L = 0

\[ R_B = \frac{F \cdot L}{2} \]

\[ R_B = \frac{F}{2} \]

\[ R_B = \frac{500}{2} = 250 \text{ N} \]

\[ \sum F_r = 0 \]

\[ R_A + R_B - F = 0 \]

\[ R_A = F - R_B \]

\[ R_A = 500 - 250 = 250 \text{ N} \]

\[ M_C = R_B \times \frac{55}{2} \]

\[ M_C = 250 \times 22.5 = 5625 \text{ Nmm} = 5.625 \text{ Nm} \]
Diagram force move and moment of the knife when process press the mente.

$$\sum M_A = 0$$

Moment maximum occur at point C

$$\sum AM = 0$$

Picture 4.1

Picture 4.2

Moment bent endurance, $$W_b = \frac{bh^2}{6} = \frac{55 \times (20)^2}{6} = 3666.7 \text{ mm}^3$$

Tension maximum, $$\sigma_{\text{max}} = \frac{M_{\text{max}}}{W_b} = \frac{5625}{3666.7} = 1.5 \text{ N/mm}^2$$

Tension bent = \(\frac{3}{4}\) tension pull, because used material ST. 42 with tension pull maximum 420 N/mm\(^2\), so tension bent maximum = \(\frac{3}{4}\) 420 = 315 N/mm\(^2\).

Tension bent allowance, $$\sigma_b = \frac{\sigma_{b_{\text{max}}}}{v}$$, where v = safety factor, taken 6.

$$\sigma_b = \frac{315}{6} = 52.5 \text{ N/mm}^2$$

Calculation found value tension bent allowance more than tension bent maximum \((\sigma_b > \sigma_{b_{\text{max}}})\) at the bench. Mean the knife able to endurance the load occured without to be bent.
b. Force Stick Press
By experiment force press at the mente found force press is 500 N
\[ F = 2a \times \frac{F_t}{d} \]
Explanation:
- \( F \) = Force from experiment with used test machine pull/press (Galdabini), when the tested can be seen at enclosure.
- \( F_t \) = Force stick press (N)
- \( a \) = Length stick press = 250 mm
- \( dp \) = Diameter stick press = 20 mm
- \( F_t = (500 \times 20) / (2 \times 250) = 20 \text{ N} = 2 \text{ Kg} \)

c. Work to treat the Pressure
\[ W = F_t \times a \]
Where:
- \( W \) = Work (joule)
- \( F_t \) = Force stick press (N)
- \( a \) = distance transfer force = 5 mm = 0.05 m (assumption)
- \( W = 20 \times 0.05 = 1 \text{ Nm atau 1 Joule} \)
d. Power Kacip Mente
\[ P = \frac{W}{t} \]
Where:
- \( P \) = power tool press 0.2 watt.
- \( W = 0.2 \text{ Joule} \).
- \( t = \text{time} / \text{time press (second)} \)
e. Force able to endurance by axle press
\[ F = \frac{\pi^2 EI}{4V(2l)^2} \]
Where:
- \( F \) = Force (kg)
- \( E \) = Modulus Elastic (N/mm\(^2\))
- \( I \) = Moment inertia (mm\(^4\))
- \( V \) = Coefisien safety for steel 3-5
- \( l \) = High distance from axle at load (mm)
- \( d \) = Diameter axle press (mm)
- \( I = \frac{\pi d^4}{64} = 3.14 \times (35)^4 / 64 = 73624.4 \text{ mm}^4 \)
- \( F = \frac{\pi^2 EI}{4V(2l)^2} \)
- \( F = \frac{(3.14)^2 \times 210.10^3 \times 73624.4}{4 \times 5 \times (2 \times 180)^2} = 23524.76 \text{ N} = 2352.5 \text{ Kg.} \)
Therefore, axle press safefor received loaded 500 N, because load maximum can be endurance axle press is 23524.7 N atau 2352.5 Kg

f. Calculation Bolt Strength Axle Press
\[ \sigma_t = \frac{F}{A} \]
\[ A = \pi d_t^2/4 \]
\[ \sigma_t = \frac{4F}{\pi d_t^2} = \frac{4 \times 500}{3.14 \times (8)^2} = 9.96 \text{ N/mm}^2 \]
Whereas tension pull/press for bolt M8 as the next:
Data tension pull bolt allowance (\( F_{t izin} \)) = 21 KN or same with 21000 N.
\[ \sigma_{t izin} = \frac{F_{t izin}}{A} \]
\[ A = \pi d_{t izin}^2/4 \]
\[ \sigma_{t izin} = \frac{4F_{t izin}}{\pi d_{t izin}^2} = \frac{4 \times 21000}{3.14 \times (8)^2} = 418.3 \text{ N/mm}^2 \]
Because tension pull bolt more than small from tension pull allowance for bolt M8 (σ_t < σ_t allow), so bolt was safe and was not damage.

g. Calculation Strength Weld at the Plat Scaffold
1. Gusset

\[ F = A \cdot \sigma_t \]

*Where:*
- \( \sigma_t \): Tension in elektroda/wire weld = 42 Kg/cm^2.
- \( F \): Force (Kg)
- \( A \): Surface horizontal result weld (cm^2)
- \( a \): Thick weld = 0.6 cm.
- \( l \): Length result weld = 1 cm.

Therefore
\[ a = \frac{1}{2} \sqrt{2} \] (because angle weld 45° or same with sin 45)
\[ = 0.5 \times 1.4 = 0.7 \text{ cm} \]
\[ A = 2 \cdot a \cdot l \] (because has 2 result weld, therefore times 2)
\[ = 2 \cdot 0.7 \cdot 0.1 = 0.14 \text{ cm}^2 \]

Angle \( \alpha \) as tension at the surface weld is 45°, mean occur tension moved.

At the table \( \alpha \) so that:
\[ \alpha = 45^\circ \]
\[ \frac{\tau_l}{\tau_t} = 0.85 \]
\[ \text{jadi} \quad \tau_l = 0.85 \cdot \tau_t = 0.85 \cdot 42 = 35.7 \text{ Kg/cm}^2 \]

Therefore, \( F = A \cdot \tau_l = 0.14 \cdot 35.7 = 4.99 \text{ Kg or } 5 \text{ Kg} \)

So that, force can be received by result weld 5 Kg as force must be received by result weld 4.9 Kg (massa total components kacip at page 19). Mean the result weld was safe.

2. Column

\[ F = A \cdot \sigma_t \]

*where:*
- \( \sigma_t \): Tension in elektroda/wire weld (Kg/cm^2)
- \( F \): Force (Kg)
- \( A \): Surface horizontal result weld (cm^2)
- \( a \): Thick weld (mm)
- \( l \): Length result weld (mm)

Data:
\[ a = 4 \text{ mm} = 0.4 \text{ cm} \]
\[ l = 30 \text{ mm} = 3 \text{ cm} \]
\[ \tau_t \text{ ST 42} = 420 \text{ N/mm} = 42 \text{ Kg/cm}^2 \]

\[ A = a \cdot l \]

\[ = 0.7 \cdot 3 \]
\[ = 2.1 \text{ cm}^2 \]

Angle \( \alpha \) as a tension at surface weld is 45°, an then here is occur moved tension.

At the table \( \alpha \) for:
\[ \alpha = 45^\circ \]
\[ \frac{\tau_l}{\tau_t} = 0.85 \]

\[ \text{jadi} \quad \tau_l = 0.85 \cdot \tau_t = 0.85 \cdot 42 = 35.7 \text{ Kg/cm}^2 \]

\[ \text{Therefore, } F = A \cdot \tau_l = 2.1 \cdot 35.7 = 74.97 \text{ Kg} \]

Therefore, loaded can be received by result weld is 74.97 Kg whereas loaded has to received by result weld 2.8 Kg. This mean result weld at the plat is safe.

h. Calculation Load and Tension Moved Spiral

Data:
- Total wrap (N) = 12
- Length free = 100 mm
- Diameter wrap (D) = 30 mm
- Diameter wire spiral (d) = 2 mm
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Modulus move (G) = 83 x10³ N/mm²
The length (δ) = 112 mm

Solution:

\[ C = \frac{D}{d} = \frac{30}{2} = 15 \]

\[ K = \frac{4C - 1 + 0.615}{4C - 4} + \frac{0.9}{4(15) - 4 + 0.615} = \frac{259 + 0.615}{56 + 15} = \frac{919.44}{840} = 1.09 \]

whereas loaded can be endured by spiral when pressed

\[ \delta = \frac{8WD^3n}{Gd^4} \quad W = \frac{\delta Gd^4}{8D^3n} \]

\[ W = \frac{112x(83.10³)x(2)^4}{8x(30)^3x12} = \frac{148736000}{2592000} = 57.3 \text{ N} \]

\[ \tau = \frac{K.8WC}{\pi d^2} = \frac{1.09x8x57.3x15}{3,14x(2)^2} = \frac{7494.84}{12.56} = 596.72 \text{ N/mm}^2 \]

Whereas loaded can be endurance by spiral is :

\[ W_a = \text{massa Axle press} + \text{massa Arm} + \text{massa tension press} \]

\[ W_a = 0.56 + 0.24 + 2 (\text{Kg}) \]

\[ W_a = 2.8 \text{ Kg} \]

Calculation has load of the spiral (W_a) = 2.8 Kg, maximum loaded can endured by spiral (W) = 57.3 Kg. Therefore \(W > W_a\), so the spiral and used safely.

B. Result Maker

Specification tool peeling mente has made can be seen at Table 4.1 berikut; Table 4.1. Spesification tool peeling mente.

<table>
<thead>
<tr>
<th>Material</th>
<th>ST-42</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension Length</td>
<td>220 mm</td>
</tr>
<tr>
<td>Dimension Width</td>
<td>120 mm</td>
</tr>
<tr>
<td>Dimension High</td>
<td>330 mm</td>
</tr>
<tr>
<td>Material Knife</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>Dimension top knife</td>
<td>53x35x1.2 mm</td>
</tr>
<tr>
<td>Dimension bottom knife</td>
<td>53x35x1.2 mm</td>
</tr>
<tr>
<td>Force Press</td>
<td>2 Kg</td>
</tr>
</tbody>
</table>

C. Result Experiment

Process experiment has designed with cutting knife, was experimental quality and quantity peeling.

1. Result design experiment cutting knife

Indicated dimension mente come to the data as ; 1. Length = 32 – 35 mm, 2. Width = 25 – 27 mm, 3. thick = 16 – 19 mm, 4. Radius at the back = 25 mm, 5. Radius at the front = 6 & 8 mm. Result design experiment cutting knife can be seen at table 4.2 as the next.
Table 4.2. Result experiment 3 model cutting knife.

<table>
<thead>
<tr>
<th>No.</th>
<th>Model</th>
<th>Analyse result experiment</th>
</tr>
</thead>
</table>
|     |        | b. Increase; dimension the knife average with the mente.
|     |        | c. Decrease; not fix with mente dimension more than average and result shell has crack to pinched. |
| 2.  | Knife B | 1. Model *Knife B* as the front, yet at the back (bottom knife) make ellipse.
|     |        | 2. Increase; dimension this knife model more flexibel so can peel mente with any dimension. Peel result was not divided the mente. Shell the mente free from the peel knife.
|     |        | 3. Decrease; lay the mente must with a good so process cutting mente is sharp. |
| 3.  | Knife C | 1. Model *Knife C* almost same with model *Knife B*. Bottom knife was made more wide and ellipse.
|     |        | 2. Increase; dimension knife model this more flexibel than model knife B so can peeled mente with any dimension. Peeling result was divided the mente. Shell mente free from the peeling knife.
|     |        | 3. Decrease; lay the mente must with a good process so the cutting mente is sharp. |

From this result experiment data hasil pengujian, so model knife B was used in process the next experiment, yet from the processing maker model knife C more easy to work because more wide its ellipse.

**IV. Experiment result cutting knife**

Experiment result cutting knife experiment cutting knife for to know effective length in peeling the mente so result peeling was not for cutting mente. The first data from distance top knife and bottom knife = 24 mm. Distance top knife and bottom knife at will be cut = 14 mm (calculate 0 mm step). Result experiment length step cutting knife can be seen at table 4.3 berikut.
Table 4.3. Result experiment length step cutting knife.

<table>
<thead>
<tr>
<th>No.</th>
<th>Step (mm)</th>
<th>Experiment result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>0</td>
<td>1. Before peel.</td>
</tr>
<tr>
<td>2.</td>
<td>2</td>
<td>2. Top knife has inside ± 2 mm and has pinched.</td>
</tr>
<tr>
<td>3.</td>
<td>4</td>
<td>3. Top knife has inside ± 3 mm and bottom knife inside ± 1 mm. Then bottom knife can be turn and not yet divided.</td>
</tr>
<tr>
<td>4.</td>
<td>6</td>
<td>4. Top knife inside ± 4 mm and bottom knife inside ± 2 mm. Then bottom knife can be turn and has divided but not perfect.</td>
</tr>
<tr>
<td>5.</td>
<td>8</td>
<td>5. Top knife inside ± 4.5 mm and bottom knife inside ± 3.5 mm. Then bottom knife can be turn and has divide with perfect. The mente not yet reach at bottom knife.</td>
</tr>
<tr>
<td>6.</td>
<td>10</td>
<td>6. Top knife inside ± 5 mm and bottom knife inside ± 4 mm. Then bottom can be turn and perfect. The mente reach with bottom knife.</td>
</tr>
</tbody>
</table>

Experiment result again step peel gave a good peel at inside in 8 mm.

2. Quality and quantity experiment result peel

The quality and quantity purpose experiment at tool peel mente was to know capacity of the tool. Data the quality and quantity experiment can be seen in table 4.4 as the next.

Table 4.4. Data quality and quantity experiment peeling mente.

<table>
<thead>
<tr>
<th>No.</th>
<th>Total in 1Kg</th>
<th>Time (minute, second)</th>
<th>Entire</th>
<th>Divided</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>175.0</td>
<td>29',35'</td>
<td>130</td>
<td>45</td>
</tr>
<tr>
<td>2</td>
<td>172.0</td>
<td>27',15'</td>
<td>137</td>
<td>35</td>
</tr>
<tr>
<td>3</td>
<td>173.0</td>
<td>25',20'</td>
<td>140</td>
<td>33</td>
</tr>
<tr>
<td>4</td>
<td>174.0</td>
<td>25',30'</td>
<td>143</td>
<td>31</td>
</tr>
<tr>
<td>Average</td>
<td>173.5</td>
<td>26.55'</td>
<td>137.5</td>
<td>36</td>
</tr>
<tr>
<td>Percentage</td>
<td></td>
<td></td>
<td>79.25%</td>
<td>20.75%</td>
</tr>
</tbody>
</table>

V. Discussion

Developing Design Cracker Anacardium occidentale (mente) for Home Industrial with specification data it is moveable and practice for peeling the mente.

Repaired design of cutting knife with increased capacity and quality. See table 4.4. Tool experiment result can shown the need average time for peeling mente eachs 1 Kg is 26 minute, 55 second. Time was needed for peeling mente is better than Azis’s made is 47 minute 11 second. If an hour the tool capacity could peeled 2 Kg/hour.

Increased in quality peeling is 79.25% mente the entire and 20.75 mente divided. Has increased in quality peeling than the tool by Azis was, 74.45% mente entire. Yet, from the produce target with divided mente was 20.75% its result enough many in decrease. When the experiment has done to peel it, has not dried so the mente still at its shell. But this research has to continue to know how much the temperature and the exact time for drying for quality increased result peeling.

VI. Conclusion And Recommendation

From this experiment and discussion its conclusion as the next:

Peeling mente has development design with the top of the ellipse knife. The effectively length has a quality product, maximum peeling was 8 mm with width mente average 25-27 mm. The result tool design peeling mente has increased an quality peeling mente to be 79.25% for 1 kg with peeling time in 26 minute, 55 second.

Developing Design Cracker Anacardium occidentale (mente) for Home Industrial has done at workshop with our students. We hope the produce could be continued to community by socialization and experimental. But this research has to continue to know how much the temperature and the exact time for drying for quality increased result peeling.

VII. Greeting

Thank you very much to Rector State University Makassar and Head of Research for giving me an opportunity to do my research.
Reference