Sugarcane Bark/Skin Peeling Machine

M.M. Ahmat Asim\textsuperscript{1, a}, N.N Hisyamudin\textsuperscript{2, b}, S.R. Masrol\textsuperscript{3, c}

\textsuperscript{1}Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, Batu Pahat, 86400, Johor, Malaysia
\textsuperscript{a}ad100045@siswa.uthm.edu.my, \textsuperscript{b}nhisyamd@gmail.com, \textsuperscript{c}srizal@uthm.edu.my

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\textbf{Abstract.} Due to increasing demand of sugarcane product and development of sugarcane industry a problem was found out that conservative peeling method of sugarcane would take times to cope with the increasing demand. The problem was based on our customer Sugarcane World Sdn Bhd and Natural Organic Sugarcane. A new design was proposed to solve the peeling method by designing a new blade installed with rollers to push in and out the sugarcane stalk in blade compartment. By following engineering design process the idea was transformed into CAD data and prototype was built. The newly developed prototype was tested and few data obtained gain for improvement.

\section*{Introduction}

Sugarcane bark peeling machine has been used to cut the processing time taken in order for the traders to cut cost thus gain maximum profit. Sugarcane bark peeling is the second process of obtaining sugarcane juice after removing the sugarcane leaf. Which is the sugarcane consisting of three parts husk enclosing shell, flesh and juice. Usually the cane is manually trimmed requires considerable physical strength and a very sharp knife and thus is dangerous procedure. Other problem associated with manual trimming process were shortage of skilled labor and the considerable amount of time that the trimming process takes [1].

\section*{Methodology}

Information gathering in design process discussed in more details and viewpoints where are several types of design process introduced by different authors such as G Pahl and W. Beitz was used in developing the concept.

The early stage of designing wherein defining what must be done to resolve the needs by the designer. By defining the task the designer can see general statement of the end product. Any obstacle in the flow process can be traced due to poorly stated goals or goals that hastily written thus resulted in confusion or too much flexibility.

Market study has been done in order for us to locate what is already available in the market and what they have to offer for us to improve or solve the problem. Information gathering is a vital task for designers to consult the related sources in order to determine market availability.

The flow of information gathering will follow from defining task, conceptual design, embodiment design, and detail drawing. From the information gathered an idea will be developed and will be proceed to prototyping.

\section*{Result and Discussion}
Gathered information from survey, voice of customer, benchmarking were integrated in Quality Function Deployment and new product target was obtained. With the requirement of using stainless steel material in order to protect food from corrosion and better hygiene and using motorized system is the new product target.

**Experimental data**

![Figure 1: Quality function deployment](image-url)
A test were done in order to study the compression limit or yield strength for sugarcane by using Compression and Tensile testing machine. The result obtained is used in determining spring stiffness for spring that will be holding the shaft in order to the mechanism to pull the sugarcane.

![Figure 2: Compression testing](image)

![Figure 3: Compression result of sugarcane](image)

Based on the experiment above we obtain the result of that sugarcane can withstand about 1600N 2.5mm compression with a sample height of 47mm. By means that as the compression reached
44.4mm the sugarcane fractured. Thus suitable spring stiffness should be selected below the 1600N where we consider reduction of fifty percent from original compression data which is 800N.

**Speed analysis**

The new design has product target with output product of 200 stalk per hour. Thus mathematical analysis were done in order to determine the required speed and used for further analysis on motor and shaft of the design.

Required speed: \( \omega = \frac{2\pi N}{60} \)  \hspace{1cm} (1)

\[ 200 \times 0.5m = 100m \]

\[ 1 \text{ hour} = 3600 \text{ sec} \]

\[ \frac{3600}{200} = 18 \text{ sec (for 500 mm of sugarcans)} \]

\[ v = \frac{0.5m}{18 \text{ sec}} = 0.0278m \text{ s} \]

\[ \omega = \frac{2\pi N}{60} \rightarrow \text{ converts } \omega = \frac{0.0278}{0.035} = \frac{0.79 \text{ rad}}{s} \]

\[ N = \frac{60\omega}{2\pi} \]

\[ = \frac{60 \times 0.79}{2\pi} \]

\[ 7.54 \text{ rpm} \approx 8 \text{ rpm} \]

**Components analysis**

Table 1: Components analysis

<table>
<thead>
<tr>
<th>Model Reference</th>
<th>Properties</th>
<th>Components</th>
</tr>
</thead>
</table>
Table 2: Resultant displacement

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement</td>
<td>URES: Resultant Displacement</td>
<td>0 mm</td>
<td>0.458769 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Node: 7</td>
<td>Node: 785</td>
</tr>
</tbody>
</table>

From Table 2 shows that stress analysis exerted on inclined surface of the blade causes the blade to displace by maximum 0.45mm.
Conclusion

Improvement from existing prototype done based on the obtained data and reduction of weight was done and improvement of roller system using tire instead of steel rollers. The improvements design shows that a better blade or peeling system is required in order to obtain better peeling rate at a better rate. Spring stiffness contribute largely in the design mechanism which correct selection of spring stiffness contribute to speed and better product outcome.

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References


Reference to a book: