The challenge of peeling coconut stems for high-quality veneer.

Thanks to Rob McGavin and the QDAF team for the base presentation content.
Content

• The challenge of peeling coconuts
• ENSAM trial results.
• Implementing results in commercial and research trials.
• Take home messages for successful coconut processing.
Variation in coconut wood character

Image from QDAF CocoWood project
Complexity in veneering

The key challenges include:

- Slicing the hard vascular bundles without undue damage to the surrounding soft matrix.
  - To manage surface coarseness & reduce sheet damage.
- Recovering useful material from small diameter logs.
- Accommodating varying density across the log.

Controlled spindleless lathe approaches offered a possible solution.
Ensam Micro-lathe
Ensam trial - Range of parameters

Disk

Nose bar

Veneer

Knife

G : Gap between knife and nose bar
E : Veneer Thickness
Ch : Horizontal Gap
Cv : Vertical Gap
Ensam Trial - Range of parameters

Angular

Cylindrical

Nose bar Ø 8 mm
Bracket
Angular nose bar
Needle bearings
Trial 1 - Range of parameters trialed

Lathe checks
Temperature effect

### Experiment plan

<table>
<thead>
<tr>
<th></th>
<th>50 °C</th>
<th>60 °C</th>
<th>70 °C</th>
<th>80 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 h</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>4 h</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>x</td>
</tr>
</tbody>
</table>

### Results

<table>
<thead>
<tr>
<th>Effort (N/cm)</th>
<th>50°C</th>
<th>60°C</th>
<th>70°C</th>
<th>80°C - 1h</th>
<th>80°C - 4h</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>66</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Conclusion

- Temperature
- Time

- 80°C
- 1 hour (disc)
Pressure

Experiment plan

<table>
<thead>
<tr>
<th>Nose bar</th>
<th>5%</th>
<th>7%</th>
<th>10%</th>
<th>12%</th>
<th>15%</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angular</td>
<td>×</td>
<td>-</td>
<td>×</td>
<td>-</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Cylindrical</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
</tbody>
</table>

Observations

Angular:
- Chipping
- Image analysis (SMOF) impossible

Cylindrical:
- Continuous ribbon (low and medium density)
- Image analysis (SMOF) possible (low and medium density)
Experimental Investigation on Rotary Peeling Parameters of High Density Coconut Wood

Henri Bailleres, Louis Denaud, Jean-Claude Butaud, and Robert L. McGavin

Substantial quantities of senile coconut palms are present in plantations within the Asia-Pacific region. Once coconut palms become over-mature, their production of traditional products, such as coconuts, significantly decreases, resulting in profitability challenges for farmers. Presently, few profitable markets exist for over-mature, senile coconut palms. Using the coconut palm stem in composite or engineered wood products could, however, provide an attractive alternative. Due to some of its unique characteristics, a processing system able to recover wood from the high-density zone near the stem periphery is desirable. A series of rotary veneer laboratory trials were undertaken to establish fundamental benchmark lathe settings and veneering characteristics for coconut palm stems. Different pressure bar configurations, billet pre-treatment temperatures, and veneer thicknesses were tested, and the resulting cutting forces and veneer quality were assessed. Optimal setting recommendations for peeling coconut wood are provided.
Conclusion on the best settings

- Heating of discs to a temperature 80 °C for 1 hour.
- Cylindrical bar pressure
- Pressure sufficient for 10% veneer compression.

The implementation on a production lathe requires a relatively large diameter, cylindrical nose bar in order to make the pressure more uniform.
Peeling trials - initial

Advanced veneer and other product from coconut wood
Peeling trials - initial

Initial experimental peeling trial in Fiji

- Lathe performed well
- 23 logs (1.5 m3) processed, 249 veneer sheets produced.
- Around 60% recovery
- Supporting equipment problems:
  - Pretreatment chamber couldn’t heat logs sufficiently!
- Veneer quality negatively impacted by:
  - Lack of log heating capacity.
  - Lack of opportunity to optimise lathe settings.

Advanced veneer and other product from coconut wood
VTB commercial peeling trial

Advanced veneer and other product from coconut wood
VTB commercial peeling trial

Advanced veneer and other product from coconut wood
VTB commercial peeling trial

Advanced veneer and other product from coconut wood
VTB commercial peeling trial

Advanced veneer and other product from coconut wood
Compact commercial peeling trial in Fiji

– 171 of 2500mm billets processed.
– About 15 m3 of veneer produced.
– No drying challenges.
– Good quantity of suitable quality veneer for product development activities.
– Equipment issues demonstrated the challenges of peeling coconut.
– Equipment performance and surface quality issues reinforced the necessity of billet pre-conditioning.
Further peeling trials at TUD, Suva

Additional log heating capacity was installed.
Heating assessment
Peeling heated logs with improved settings
Improved peeling quality observed

Veneer grade recovery and quality through the log currently being assessed.
Recovered coconut veneer was graded but this presented challenges.

- The major grading criteria for wood species don’t relate well to coconut.
- Grade-reducing characteristic common for wood species in the standards don’t apply to coconut.
  - The basic characteristics of the coconut veneer vary considerably and need be included in
- Some desirable features of coconut, such as density, are not prominent or included.
- Production-induced characteristics can dominate grading if not controlled during production.
Rotary veneer processing presents several advantages over conventional sawing. These include:

• Recovering around double the usable product from logs.

• Much higher recovery from the periphery of logs.
  – In coconuts, this can have the most attractive characteristics and properties.

• Easier management of the log’s variable properties.

• Faster veneer drying than sawn timber with less degrade.

• The use of logs unsuitable for sawmilling.
  – Generally shorter, smaller diameters logs.
The project has demonstrated that coconut palms can be rotary peeled using currently available spindle-less lathe technologies.

- These approaches overcome the barriers to peeling coconut using traditional methods.
The project has identified:

- The need for specific lathe setups and processing protocols to produce quality coconut veneer.
- The recovered veneer has a wide range of qualities (mechanical, physical and appearance).
- To gain the most value from the veneer, careful grading and segregation is needed to manage this range of qualities.
- Effective veneer grading systems need to be developed along the supply chain: between the processor, product manufacturer and the customer to allow efficient trade of the material.