Comparative Properties of Bagasse Particleboard (BPB)
Sugar Cane Processing
Sugar Industry In Louisiana

- Second largest plant commodity in Louisiana
- Producing $500 Million/year in sugar-related products
- Producing 16 Million tons of bagasse as by-product
Harvested Sugar Cane
Sugar Extraction
By-Product - Bagasse
By-Product - Bagasse
About 30% of the 16 Million tons of bagasse available for fiber sources in Louisiana annually.
Bagasse Fiber

- Bagasse contains about 65 percent fiber, 25 percent pith cells, and 10 percent water soluble.
- Bagasse fibers average 1.5 to 2 millimeters (0.06 to 0.08 inch) in length. They are relatively fine and their chemical properties are similar to those of hardwood fibers.
- An essential element in the conversion of bagasse to a satisfactory paper is the mechanical removal of a substantial proportion of the pith prior to the pulping operation.
- Bagasse particleboard (BPB) uses all bagasse.
Bagasse
Particleboard Manufacturing
Bagasse Drying
Bagasse Size Reduction
Bagasse PB – Blending
Bagasse PB – Pressing
Bagasse PB – Pressing
Bagasse PB – Pressing
Bagasse PB – Panel Cooling
Bagasse PB – Sanding
Bagasse PB – Finished Panel
Laminated Flooring
Laminated Flooring

1. The Laminate Surface. A clear wear layer for super protection.

2. The Image Layer. This layer for providing a hardwood look.

3. The Core. High Density Fiberboard (HDF) for moisture resistance and indentations.

4. The Laminate Backing. A thermo-fused backing for additional strength and protection.
Objective

Developing bagasse particleboard (BPB) for laminated flooring applications
Technical Information of Bagasse Particleboard (BPB) Used in the Study

<table>
<thead>
<tr>
<th>Fiber Type</th>
<th>Resin (pMDI) Content (%)</th>
<th>Target Thickness (mm)</th>
<th>Target Density (g/cm³)</th>
<th>Resination Time (Second)</th>
<th>Press Temperature (C)</th>
<th>Press Cycle (Second)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-year old bagasse fiber hammer milled through a 6-mm screen</td>
<td>5%</td>
<td>6.35</td>
<td>0.72&lt;sup&gt;a&lt;/sup&gt;</td>
<td>240</td>
<td>185</td>
<td>165</td>
</tr>
<tr>
<td></td>
<td>8%</td>
<td></td>
<td>0.88&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.72&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.88&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: <sup>a</sup> – BPB1, <sup>b</sup> – BPB2, <sup>c</sup> – BPB3, and <sup>d</sup> – BPB4.
Testing of Bagasse Particleboard

Test Performed:
- Bending MOE/MOR
- IB and Hardness
- Screw Holding
- Linear Expansion
- Thickness Swell

Test Standards:
- ANSI/A208.1 (1999)
- ANSI/A208.2 (1994)
- ASTM D1037 (1996)
Bagasse PB Samples

TS

Bending
MOE/MOR

IB

Linear
Expansion
Bagasse PB Testing

Internal Bond

Hardness
Results and Discussions
Density profile

![Density profile graph](image-url)

- **X-axis**: Position (mm)
- **Y-axis**: Density (g/cm³)

Legend:
- Blue line
- Yellow line
- Pink line

Graph showing the density profile over position.
Bending Modulus

\[ y = 11.641x - 6.5015 \quad R^2 = 0.781 \]

\[ y = 0.9967x + 2.9119 \quad R^2 = 0.0017 \]

Density (g/cm³) vs. MOE (GPa) graph with data points and linear regression lines for 5% RC and 8% RC. The graph shows a significant correlation for 8% RC with a high R² value, indicating a strong linear relationship. For 5% RC, the correlation is weak with a low R² value.
Bending Modulus

<table>
<thead>
<tr>
<th>Board Type</th>
<th>MOE (GPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI A208.1</td>
<td>2.66</td>
</tr>
<tr>
<td>BPB1</td>
<td>3.65</td>
</tr>
<tr>
<td>BPB2</td>
<td>3.73</td>
</tr>
<tr>
<td>BPB3</td>
<td>2.25</td>
</tr>
<tr>
<td>BPB4</td>
<td>3.50</td>
</tr>
</tbody>
</table>
Bending Strength

\[ y = 77.716x - 39.453 \quad R^2 = 0.8712 \]

\[ y = 39.15x - 7.7643 \quad R^2 = 0.07 \]
Bending Strength

- **Board Type**: ANSI A208.1, BPB1, BPB2, BPB3, BPB4
- **MOR (MPa)**: 15, 25, 25, 19, 28
IB Strength

\[ y = -1.7042x + 3.4738 \]
\[ R^2 = 0.0188 \]

\[ y = 8.2148x - 4.8424 \]
\[ R^2 = 0.6424 \]

<table>
<thead>
<tr>
<th>Density (g/cm³)</th>
<th>IB (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>0.7</td>
</tr>
<tr>
<td>0.5</td>
<td>0.8</td>
</tr>
<tr>
<td>1.0</td>
<td>0.9</td>
</tr>
<tr>
<td>1.5</td>
<td>1.0</td>
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<td>2.0</td>
<td>1.1</td>
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<tr>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>3.0</td>
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<td>3.5</td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td></td>
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</tbody>
</table>

5%RC
8%RC
Linear (5%RC)
Linear (8%RC)
Hardness

\[ y = 2509.4x - 1310.8 \]
\[ R^2 = 0.8113 \]

\[ y = 2812.6x - 1654 \]
\[ R^2 = 0.4319 \]
Hardness

Hardboard BPB1 BPB2 BPB3 BPB4

<table>
<thead>
<tr>
<th>Board Type</th>
<th>Hardness (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardboard</td>
<td>1200</td>
</tr>
<tr>
<td>BPB1</td>
<td>1000</td>
</tr>
<tr>
<td>BPB2</td>
<td>800</td>
</tr>
<tr>
<td>BPB3</td>
<td>600</td>
</tr>
<tr>
<td>BPB4</td>
<td>1000</td>
</tr>
</tbody>
</table>
Linear Expansion

![Linear Expansion Graph]

- **Density (g/cm³)**
- **Linear Expansion (%)**

**Legend:**
- **5%RC**
- **8%RC**
Linear Expansion

Board Type

Linear Expansion (%)

ANSI A208.1  BPB1  BPB2  BPB3  BPB4

24-hour Water Soaked  0-95%RH
Thickness Swell

Extreme Edge

Edge
Thickness Swell

Center 2.54 cm
Thickness Swell

![Bar Chart]

- **ANSI A208.1**
- **BPB1**
- **BPB2**
- **BPB3**
- **BPB4**

**Board types**:
- E-Edge
- Edge
- 2.5-cm
- Center

**TS after 24 hour soaking (%)**

Values range from 0 to 18%.
Conclusions

All mechanical properties are highly correlated with the panel density. LE and TS showed less dependence on the density.

Increase in resin content level led to higher strength and less swelling in general. All products showed high strength properties, well exceeding the performance levels specified in the ANSI standard.

LE was higher than the critical value of 0.35 percent prescribed in the standard. TS for panels at 8% resin level met the 8% TS requirement (based on 24-hour water soaking), while those at 5% resin level exceeded the level.

A consistent, high performance agrifiber composite panel with desirable environmental attributes could be successfully developed.