CHARACTERISATION OF FIBERS FROM CARIBBEAN SACCHARUM OFFICINARUM

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Summary

I. Introduction to the plant
   Saccharum Officinarum

II. Fiber extraction method

III. Characterization

IV. Results and discussion

V. Conclusion

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Introduction to the plant

- *Saccharum officinarum* from New Guinea
- Family: Poaceae (graminae)
- Introduced in 1493 in Caribbean islands by Cristobal Colon
- 12 months culture, in tropical area
- Climatic conditions
  - Sun
  - Water
  - Soil element
- World production
  - 1290 million tones of cane stalk
  - 413 million tones of bagasse

- Production Martinique
  - 202 ktons/year
    - 35% sugar mill *le Galion*
    - 65% alcohol mill (9x)
Common application of bagasse

- Ciment-Bagasse planks and boards
- Rayon
- Panels
- Paper for newspaper
- Composites material
- Dietary packaging
- Combustible
Chemical composition of sugarcane

<table>
<thead>
<tr>
<th>Components</th>
<th>Sugarcane</th>
<th>Bagasse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulose</td>
<td>32-48%</td>
<td>43-45%</td>
</tr>
<tr>
<td>Hemicellulose</td>
<td>27-32%</td>
<td>25-27%</td>
</tr>
<tr>
<td>Lignin</td>
<td>19-24%</td>
<td>20-22%</td>
</tr>
<tr>
<td>*Solubility in hot water</td>
<td>6.2%</td>
<td>4.1%</td>
</tr>
<tr>
<td>Ash</td>
<td>1.4%</td>
<td>2.6%</td>
</tr>
</tbody>
</table>

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Extraction method of fibres

- Mechanical Extraction
- Steam Explosion
- Enzymatic
- Kraft Process
- Retting
- Stripping
### Extraction

#### Materials and Methods

**Prehydrolysis**

- Kawabata single hair tester KES-FB2 SH
- Tensile Dynamometer tester MTS
- Scanning electron microscope SEM

**Standard conditions**: 20°C, 65% HR

**Alkaline cooking**

- 1N NaOH
- 0.1N NaOH

**Washing**

<table>
<thead>
<tr>
<th>Condition</th>
<th>1N NaOH</th>
<th>0.1N NaOH</th>
</tr>
</thead>
<tbody>
<tr>
<td>With prehydrolysis</td>
<td>β1</td>
<td>B2</td>
</tr>
<tr>
<td>Without prehydrolysis</td>
<td>β3</td>
<td>β4</td>
</tr>
</tbody>
</table>
Bagasse from sugar mill

Crushed cane

Rind cane

Prehydrolysis
NaOH 1N

Prehydrolysis
NaOH 0.1N

Prehydrolysis
NaOH 2N
The amount of lignin removed depends on the severity of the treatment.
Fiber fineness

Length's repartition of β1

Center of length's class in mm

Length's repartition of β2

Center of length's class in mm

Length's repartition of β3

Center of length's class in mm

Length's repartition of β4

Center of length's class in mm
## Fiber fineness

<table>
<thead>
<tr>
<th>Bagasse fibres</th>
<th>Mean Length (mm)</th>
<th>Barbe (mm)</th>
<th>Hauteur (mm)</th>
<th>Linear density (tex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>β1 fibres</td>
<td>29.8</td>
<td>33.20</td>
<td>31.52</td>
<td><strong>32.1</strong></td>
</tr>
<tr>
<td>β2 fibres</td>
<td>45.6</td>
<td>47.88</td>
<td>42.66</td>
<td>38.7</td>
</tr>
<tr>
<td>β3 fibres</td>
<td>37.7</td>
<td>39.28</td>
<td>36.72</td>
<td>35.0</td>
</tr>
<tr>
<td>β4 fibres</td>
<td>37.6</td>
<td>42.93</td>
<td>40.89</td>
<td>49.0</td>
</tr>
</tbody>
</table>

* CV% is over 50% for all treatments*
Bending Rigidity

\[ M (\text{gf.cm/cm}) \]

\[ K (\text{cm}^{-1}) \]

\[ M (\text{gf.cm/cm}) \]

\[ K (\text{cm}^{-1}) \]
## Bending Rigidity

<table>
<thead>
<tr>
<th>Bagasse fibres</th>
<th>Mean Length (mm)</th>
<th>Bending rigidity gf.cm²/fiber bundle</th>
<th>Bending hysteresis gf.cm/fiber bundle</th>
<th>Linear density (tex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>β1 fibres</td>
<td>29.8</td>
<td>0.13</td>
<td>0.12</td>
<td>32.1</td>
</tr>
<tr>
<td>β2 fibres</td>
<td>45.6</td>
<td>0.45</td>
<td>0.18</td>
<td>38.7</td>
</tr>
<tr>
<td>β3 fibres</td>
<td>37.7</td>
<td>0.32</td>
<td>0.35</td>
<td>35.0</td>
</tr>
<tr>
<td>β4 fibres</td>
<td>37.6</td>
<td>-</td>
<td>-</td>
<td>49.0</td>
</tr>
</tbody>
</table>
As a function of the alkaline concentration

<table>
<thead>
<tr>
<th>Bagasse fibres</th>
<th>Tenacity (cN/tex)</th>
<th>Extension to break (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>β3 fibres</td>
<td>15.63</td>
<td>2.84</td>
</tr>
<tr>
<td>β4 fibres</td>
<td>18.13</td>
<td>3.13</td>
</tr>
</tbody>
</table>

Initial Length 30mm
Yarn from sugarcane bagasse
By classical spinning

- 70% extracted bagasse fibers
- 30% cotton fiber

Wet material

4000 Tex

80 Tex
Yarn from sugarcane bagasse

810 Tex
Conclusion and Perspectives

- EXTRACTION: Alkaline concentration most effective parameter affects the fiber fineness the content of lignin extraction

- Heterogenous fiber are obtained by chemical way despite a preselection -> fibers seam difficult to operate

- CHARACTERIZATION: optimize the measurement method

- APPLICATION: Classical spinning is not adapted
  - More extraction or spinning process have to be investigated to reach the cellulosic ultimate fibers
Thank you for your attention