Fiber Modification
Fiber Strength Retention
Fiber Strength Retention

Project Objective

Tailor pulping and bleaching technologies to improve fiber strength and surface properties for specific end-uses.
Fiber Strength Retention

- Fiber Strength Retention
  - Batch kraft cooks made, kappa no. 38-20
  - SuperBatch™ cook made kappa 20
Fiber Strength Retention

- Significance - Retention of inherent fiber strength will allow for more effective use of fiber raw materials, improved machine performance, and reduction of reinforcing pulp required for some grades.

- Approach - Prepare pulps from So. Pine wood source with low MFA. Compare zero span strength with % cellulose. (Page protocol)
Fiber Strength Retention

- Page protocol for evaluating pulping and bleaching processes
Mature Southern Pine chips (50-60 yrs.) obtained. Ave. MFA measured at 22°.

- Standard kraft pulps made, 38 28, 19 kappa.
- Lo-Solids™ pulp made kappa no. 35
- Super-Batch™ pulp made kappa no. 19
- Pulps bleached with D(EPO)DED
# Fiber Strength Retention

*Kraft Pulps*

<table>
<thead>
<tr>
<th>Cook</th>
<th>Total Yield</th>
<th>Screened Yield</th>
<th>Kappa</th>
<th>Viscosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batch</td>
<td>43.1</td>
<td>41.5</td>
<td>19.1</td>
<td>18.4</td>
</tr>
<tr>
<td>Batch</td>
<td>45.5</td>
<td>44.8</td>
<td>28.8</td>
<td>32.6</td>
</tr>
<tr>
<td>Batch</td>
<td>46.1</td>
<td>41.9</td>
<td>38.7</td>
<td>33.8</td>
</tr>
<tr>
<td>Super Batch</td>
<td>45.0</td>
<td>44.1</td>
<td>19.5</td>
<td>37.6</td>
</tr>
<tr>
<td>Lo-Solids</td>
<td>47.9</td>
<td>46.8</td>
<td>35.1</td>
<td>41.2</td>
</tr>
</tbody>
</table>
# Fiber Strength Retention

**D(EOP)DED Bleaching Summary**

<table>
<thead>
<tr>
<th>Pulp</th>
<th>% ClO₂</th>
<th>% NaOH</th>
<th>Brightness</th>
<th>Viscosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kappa 19.1</td>
<td>3.12</td>
<td>3.55</td>
<td>88.8</td>
<td>9.89</td>
</tr>
<tr>
<td>Kappa 28.8</td>
<td>4.09</td>
<td>3.60</td>
<td>88.4</td>
<td>14.3</td>
</tr>
<tr>
<td>Kappa 38.7</td>
<td>5.18</td>
<td>3.65</td>
<td>88.1</td>
<td>15.6</td>
</tr>
<tr>
<td>SB Kappa 19.5</td>
<td>3.25</td>
<td>3.62</td>
<td>88.4</td>
<td>12.8</td>
</tr>
</tbody>
</table>

*0.8% H₂O₂ used in (EOP)*
Fiber Strength Retention

- Unbleached pulps refined 4000 revs. Bleached pulps refined 3000 revs.
- “Well-bonded” handsheets made at three pressures, 50, 100, 500 psig.
- Zero span strength measured.
Fiber Strength Retention

Viscosity vs. Bleach Stage

- Kappa 19.1
- Kappa 28.8
- Kappa 38.7
- SB Kappa 19.5

Bleach Stage

- Brown
- (EPO)
- D1
- D2

Viscosity
Fiber Strength Retention

Fiber Length

Length Weighted Fiber Length

Kappa No.

LW Length, mm

UB
UB 4000
B
B 3000

19.1
SuperBatch 19.5
28.8
38.7
Fiber Strength Retention

Density vs. Wet Pressing

- Closed symbols - unbleached
- Open symbols - bleached

Kappa 38.7
Kappa 28.8
Kappa 19.1
Superbatch
LoSolids
Fiber Strength Retention

Scattering Coefficient vs. Wet Pressing

Scattering Coefficient vs. Wet Pressing

- Closed symbols - unbleached
- Open symbols - bleached

- Kappa 38.7
- Kappa 28.8
- Kappa 19.1
- Superbatch
- LoSolids

Graph showing the relationship between scattering coefficient and wet pressing pressure.
Fiber Strength Retention

Zero Span vs. Wet Pressing

- **Closed symbols - unbleached**
- **Open symbols - bleached**

- Kappa 38.7
- Kappa 28.8
- Kappa 19.1
- Superbatch
- LoSolids
## Fiber Strength Retention

### Zero Span Results

<table>
<thead>
<tr>
<th>Pulp</th>
<th>Viscosity</th>
<th>ZST@50</th>
<th>ZST@100</th>
<th>ZST@500</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.1 U</td>
<td>18.4</td>
<td>175</td>
<td>180</td>
<td>178.2</td>
</tr>
<tr>
<td>19.1 B</td>
<td>9.89</td>
<td>154</td>
<td>153</td>
<td>149.8</td>
</tr>
<tr>
<td>% Change</td>
<td>46.3%</td>
<td>12.0%</td>
<td>15.0%</td>
<td>15.9%</td>
</tr>
<tr>
<td>SB 19.5 U</td>
<td>37.6</td>
<td>185</td>
<td>178</td>
<td>174</td>
</tr>
<tr>
<td>SB 19.5 B</td>
<td>12.8</td>
<td>158</td>
<td>151</td>
<td>149.1</td>
</tr>
<tr>
<td>% Change</td>
<td>66.0%</td>
<td>14.6%</td>
<td>15.2%</td>
<td>14.3%</td>
</tr>
</tbody>
</table>
## Fiber Strength Retention

### Zero Span Results

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<th>Viscosity</th>
<th>ZST@50</th>
<th>ZST@100</th>
<th>ZST@500</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.8 U</td>
<td>32.6</td>
<td>174</td>
<td>174</td>
<td>170.1</td>
</tr>
<tr>
<td>28.8 B</td>
<td>14.3</td>
<td>157</td>
<td>164</td>
<td>150.9</td>
</tr>
<tr>
<td>% Change</td>
<td>56.1%</td>
<td>9.8%</td>
<td>5.7%</td>
<td>11.3%</td>
</tr>
<tr>
<td>38.7 U</td>
<td>33.8</td>
<td>172</td>
<td>178</td>
<td>178.6</td>
</tr>
<tr>
<td>38.7 B</td>
<td>15.6</td>
<td>156</td>
<td>163</td>
<td>155.8</td>
</tr>
<tr>
<td>% Change</td>
<td>53.9%</td>
<td>9.30%</td>
<td>8.43%</td>
<td>12.8%</td>
</tr>
</tbody>
</table>
Fiber Strength Retention

- Loss of fiber length with bleaching from 6% (kappa 38.7) to 12% (kappa 19.5).
- Loss of zero span on bleaching 12-16% at low kappa, 6-13% at higher kappa.