Optimizing Your Process Through Lignin Management

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What are we measuring today??

- O₂ Delignified Pulp
- Unbleached Fibers
- Fiber Bound Lignin
- Black Liquor
- Dissolved Lignin
True Measurement of Lignin in Filtrate

Paper Week 2014 “Is Conductivity the Best Measurement of Carryover?”
Andersson et al
Why do we measure fiber lignin?

• **Digester Control**
  – Increase yield by cooking to a higher kappa

• **Oxygen Delignification Control**
  – Make our target

• **Bleach Plant**
  – Measure carry over
  – Control Chemical Dosage in the D0 stage
Measuring Fiber Lignin

- Manual Testing
- Central Analyzer
- Single Point Analyzer
Kappa Analyzer

Functions
Screening
Washing
Measurement
Reporting

Advantages
Remove lab bias
Test is performed the same way every time

Disadvantages
Long distance from sampler to central analyzer
Slow update time to DCS
Maintenance requirement is high
Multi-Point Kappa Analyzer: Total Cost of Ownership

**Installation Cost**
- Site Preparation
- Water (filtering, heating)
- Air
- Enclosure (site preference)

**Annual Service Contract**
- Ongoing supplier support
  + Local E&I oversight

**Spare Parts**
- UV Lamp once per year
- Valve Rebuild Kits
- Agitator motors, parts

\[ \sim \$250K \text{ US} \]
Installation of Single Point Kappa Analyzer
Pulping Control Benefits

**Batch Digesters**
- Faster update means 2-3 samples per blow
- Allows for individual adjustments of Chemical to Wood ratio and/or H-factor targets
- Can be on a Grade Recipe or Digester basis
- Yield increases of 0.5% - 2.0% possible

**Continuous Digesters**
- Up to 12 samples per hour
- Allows for quicker coordinated adjustments of temperature & management of cooking zone

**O2 Delignification & Bleaching**
- Faster update and increased % uptime for tighter kappa factor control and optimization of chemicals
Green Bay Packaging Morrilton
Single Point Kappa Calibration

$R^2 = 0.8161$
Kappa Shift Increases Yield:

- Green Bay Packaging Morrilton - 800 TPD Brown Mill
- Typical Kappa range 91 to 101
- 2.96 increase in Blow line Kappa
- Currently verifying reduced chip usage/increased yield
Less Manipulation of Alkali to Wood Ratio

<table>
<thead>
<tr>
<th>Alkali/Wood Ratio</th>
<th>Before SPK</th>
<th>After SPK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio Changes</td>
<td>253</td>
<td>133</td>
</tr>
<tr>
<td>Average ratio</td>
<td>13.60</td>
<td>13.16</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.59</td>
<td>0.31</td>
</tr>
</tbody>
</table>
Benefits of Automated Testing Seen By Green Bay Packaging Morrilton

• 29% Reduction in Kappa Standard deviation
• Operators have raised the kappa target; more confident in the result
• 47% reductions in changes to Alkali to Wood Ratio
• Papermakers have a better indication of what is coming to the wet end
  • Eliminate unnecessary adjustments causing sheet breaks; 1 break = 36 minutes lost time
How can we measure everything in the pulp suspension???
Bleach Load Measurement

• Current measurement options
  – Conductivity → indirect
  – Kappa → discontinuous
  – COD → laboratory, time, expensive
  – Chemical residual → inline

• Versus Bleach Load measurement

- \( \text{O}_2 \) Delignified Pulp
- Unbleached Fibers
- Fiber Bound Lignin
- Black Liquor
- Dissolved Lignin
- Bleach Load
Bleach Load Transmitter

- Optical **Reflectance Measurement**
- 5 LEDs in the sensor
  - Blue
  - Red
  - Green
  - NIR
  - UV
- UV technology similar to kappa analyzer, but in an LED & probe form
- Measures fiber kappa and filtrate kappa to give the total bleaching demand
How to Measure Bleach Load:

1. Measure Consistency of the sample
2. Fiber kappa test (lignin per gram of fiber)
3. Kappa test on the filtrate (lignin per grams of filtrate)
4. Add the two results to compute “Bleach Load”

• Use Bleach Load to develop a mathematical relationship between the sensor signals and the lab test
Suggested Sensor Placement for Control Strategy at D100
Bleach Load Calibration at Feed to Bleach

Bleach Load Transmitter Vs. Lab
Feed to Bleach - Swing Mill

\[ R^2 = 0.8816 \]
Using Bleach Load In Existing D100 Control
USA Mid West Mill

<table>
<thead>
<tr>
<th></th>
<th>Tons Per Day</th>
<th>Bleach Load</th>
<th>Kappa Factor</th>
<th>% ClO₂ Applied</th>
<th>Operator Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>522</td>
<td>18.52</td>
<td>0.232</td>
<td>1.64</td>
<td>0.651</td>
</tr>
<tr>
<td>After</td>
<td>461</td>
<td>18.27</td>
<td>0.231</td>
<td>1.60</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**Mill Control Notes:**
- Uses D100 Brightness after chemical addition for feedback adjustment
- Kappa Factor calculated but not used
- Savings of $60K per year without additional improvements to existing mill control!
Reduce Chlorine Dioxide Using Bleach Load in Control
Filtrate Contribution to Total Bleach Load
Filtrate Contribution to Total Bleach Load

Percent Filtrate Kappa After Washer Adjustments

Before: 35.99%
After: 21.17%
Conclusions

• Technology exists for on-line measurement of lignin
• Replaces slow, analyzers/inaccurate manual tests
• This technology has been used to:
  - Aid in Digester Control
  - Identify Washer Issues
  - Dilution Factor Control
  - Measure Carryover to the Bleach Plant
Thank You!

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