In-line Brightness Management: Can you afford to operate without it?

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ABSTRACT

With the increased demand for recycled fiber around the world, it’s becoming more and more challenging for recycled fiber mills to get consistent quality fiber. This increased incoming brightness fiber variability puts increased pressure on the deinked fiber facility and its operators to produce consistent quality fiber to meet the mills low, medium and high brightness grade requirements.

Manual brightness measurements after the bleaching stage routinely result in the operators over-feeding the bleaching chemicals to ensure they do not produce off-quality (low brightness) pulp. There is a point of diminishing return where a large increase of the bleaching chemicals will result in little or no increase in the final brightness. The operators, concerned about producing low brightness pulp, routinely overfeed the bleaching chemicals resulting in a significant increase in costs.

In-line brightness measurement technology is available today. The instrument can be installed in-line and use a feedforward control strategy to optimize chemical consumption to produce quality pulp within brightness specifications. No more guessing how much chemical to add to reach the brightness target.

This paper will summarize a case study where the use of in-line brightness measurement technology was used to optimize a mills de-inking operation providing on-target pulp brightness to the paper machines.

Introduction

The mill consists of a single stage deinked plant producing approximately 200 TPD of pulp, two paper machines and a wet lap machine. Manual sampling & testing resulted in a delay of getting results to the operators. The delay in test results caused the operators to adopt a reactive control strategy. With the high variability incoming brightness of the pulp, it created a problem for the operators.

Problem

The deinking plant operators routinely overfed the bleaching chemicals to meet or exceed the desired brightness target to ensure that they did not produce off quality (low brightness) pulp. They often fed the bleaching chemicals well above the point of diminishing returns (See Figure 1)
**Solution**
Adjust the bleaching chemical addition rate based on the incoming brightness of the stock using an in-line brightness transmitter and a simple feedforward control strategy.

**Background**
The plan was to install an in-line brightness transmitter on the outlet of “Peroxide” tower at the location of where the lab samples were taken (Figure 2). The benefit of the in-line transmitter was the output of the continuous brightness reading versus the 2 hour lab sample. The signal would be used in a feedback control strategy to adjust the bleaching chemicals. Following BTG’s recommendation, the brightness transmitter was installed prior to the bleaching chemical addition and use a feedforward control strategy. (Figure 2)
Once the in-line brightness transmitter was installed and calibrated, the benefits became apparent. The operators were able to make adjustments to the bleaching chemicals on a real time data versus a lab sample taken every couple of hours. A simple manual control strategy was provided to the operators to make adjustments to the addition rate.

The control strategy that was implemented:

<table>
<thead>
<tr>
<th>Incoming Brightness</th>
<th>Addition Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 65</td>
<td>20#/ton</td>
</tr>
<tr>
<td>65 to 70</td>
<td>18#/ton</td>
</tr>
<tr>
<td>&gt; 70</td>
<td>14 to 16#/ton</td>
</tr>
</tbody>
</table>

As the confidence grew in the brightness transmitter, a control strategy was programmed into the DCS and the control parameters were tightened even further (Figure 3):

<table>
<thead>
<tr>
<th>Brightness</th>
<th>Addition Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>64 to 67</td>
<td>19#/ton</td>
</tr>
<tr>
<td>67 to 70</td>
<td>14#/ton</td>
</tr>
<tr>
<td>70 to 72</td>
<td>12#/ton</td>
</tr>
</tbody>
</table>
In addition to using the brightness transmitter as part of the bleaching chemical control strategy, the pulper operators started using the brightness reading to make adjustments to the furnish (Figure 4). When the incoming brightness was too low, they could never achieve the target brightness. operators will change the furnish if:

- **Incoming Brightness**
  - > 64: No changes
  - < 64 for more than 15 minutes: Change furnish to increase brightness
  - < 61 for more than 15 minutes: Change furnish again to increase brightness

Figure 3

![Brightness to Bleaching Chemical Addition](image-url)
Summary

Utilizing an in-line brightness transmitter with a feedforward control strategy resulted in a chemical cost savings. In addition, using the in-line brightness transmitter in a feedback control strategy helped reduce brightness variability. A reduction of 17% in chemical costs and furnish savings were realized utilizing a single brightness transmitter.
In-line Brightness Measurement:

Can you afford to operate without it?
Agenda

• Background
• Problem Statement
• Objective
• Project
• Benefits
• Summary
Background

• Manual sampling & testing
• Lag time to get results
• Reactive control strategy
• High variability of incoming pulp brightness
• Tried using an inline brightness meter that did not measure color
Background

Chemical Addition

Lab Sample Location
Problem

• Over application of bleaching chemicals
  – Often past the point of diminishing returns

• Manual testing
  – Could be several hours for results
    • Reactive since sample taken after addition
    • Incoming brightness variability

• Earlier attempt with inline brightness failed
  – Lack of color measurement
Problem: Over Application

Brightness to Bleaching Chemical Addition

Point of Diminishing Returns: Little to no change in brightness as dosage increases

Typical Dosage Range
Objective

Use inline brightness measurement in a feed forward control strategy to maintain target brightness to prevent over application of bleaching chemicals.
Inline Brightness Meter with Color Measurement

- Measures brightness, color (L*a*b*) and ERIC
- UV light source for measuring fluorescence
- Five analogue outputs standard
- Can input variables such as pH and consistency to provide compensated brightness
Project Scope

• Install in-line brightness transmitter prior to bleach chemical addition

• Utilize a feedforward control strategy
# Chemical addition control strategy

<table>
<thead>
<tr>
<th>Incoming Brightness</th>
<th>Addition Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manual Control</strong></td>
<td><strong>Programmed into DCS</strong></td>
</tr>
<tr>
<td>• &lt; 65</td>
<td>• 64 to 67</td>
</tr>
<tr>
<td>• 65 to 70</td>
<td>• 67 to 70</td>
</tr>
<tr>
<td>• &gt; 70</td>
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</tr>
<tr>
<td><strong>• 19#/ton</strong></td>
<td><strong>• 12#/ton</strong></td>
</tr>
</tbody>
</table>
Furnish control strategy

**Incoming Brightness**
- 64 plus
- < 64 for more than 15 minutes
- < 61 for more than 15 minutes

**Action**
- No changes
- Change furnish to increase brightness
- Change furnish again to increase brightness
Benefits

• Continuous inline brightness & color measurement

• Proactive feedforward control strategy for chemical addition

• Feedback control strategy for furnish brightness variability

• Color measurement alerts operators
Benefits

Brightness to Bleaching Chemical Addition

Target

New Dosage Range

Savings

brightness

#/ton
Benefits

Incoming Furnish Impact on Brightness

- Target
- Incoming brightness after furnish change
- Incoming furnish brightness too low
- Point of Diminishing Returns

Dosage #/Ton
Summary

• Reliable repeatable inline brightness & color measurement

• 17% cost reduction in chemical and furnish