Traditional Diagnostics Meets Industry 4.0 to Drive Yankee Performance and Safety

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Yankee Operation Priorities

Safety:
- Annual inspection
- Fitness for service inspection
- Non-routine inspection

Performance:
- Energy cost reduction
- Productivity improvement
1. Detailed and objective steam and condensate system audit
   a) Identify opportunities for system efficiency improvement
   b) Control logic optimization

2. High speed thermal imaging of Yankee
   a) Identify internal thermal anomalies with machine running
   b) Define the most energy efficient operating configuration

…but how do we take the audit on-line?

3. On-line performance monitoring
   a) “Scorecard” approach to data visualization
   b) Modular building block to Industry 4.0
Simplified Steam and Condensate Schematic
# The Audit Tool

## Machine Basics Drawings DCS Steam Tables

<table>
<thead>
<tr>
<th>Machine Basics</th>
<th>Drawings</th>
<th>DCS</th>
<th>Steam Tables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine # &amp; Location</td>
<td>Number of Straws</td>
<td>Make-up Pressure (Gauge)</td>
<td>Total Supply Density</td>
</tr>
<tr>
<td>Yankee Speed</td>
<td>ID Straws</td>
<td>Make-up Temperature (optional)</td>
<td>Blow Thru Density</td>
</tr>
<tr>
<td>Reel Speed</td>
<td>Riser ID</td>
<td>Make-up Flow</td>
<td>Condensate Density</td>
</tr>
<tr>
<td>Grade</td>
<td>Number of Headers</td>
<td>Motive Pressure (Gauge)</td>
<td>Make-up Density</td>
</tr>
<tr>
<td>Basis Weight</td>
<td>Separator Diameter</td>
<td>Motive Temperature (optional)</td>
<td>Motive Density</td>
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<tr>
<td>Reel Moisture</td>
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<td>Motive Supply Flow</td>
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<tr>
<td>Post Press Moisture</td>
<td></td>
<td>Supply Pressure (Gauge)</td>
<td></td>
</tr>
<tr>
<td>Sheet Width</td>
<td></td>
<td>Supply Temperature (optional)</td>
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<tr>
<td>Yankee Manufacturer</td>
<td></td>
<td>Blow Thru Pressure (Gauge)</td>
<td>Blow Thru Flow</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Vent or Flash Tank Flow</td>
</tr>
</tbody>
</table>

How Does it Measure Up?
Historical Review of KPI

dP vs BT

Something is wrong!
Results vs Recommended Values

- Riser Pipe / Straw Tip Area Ratio
  ✓ Ratio in range of 1.1 - 1.3

- Blow-Through / Supply Steam Ratio
  ✓ Ratio in range of 35% - 40%

- Straw Tip Blow-Through Velocity
  ✓ Velocity in range of 45 - 70 m/s
When to Consider High Speed Thermal IR

- Moisture 2-sigma more than 0.75
- Venting steam to avoid flooding
- Yankee floods occasionally
- Higher blow-through now needed to maintain dP
- Higher dP at the same BT flow

- High steam use or high blow-through rate based on the steam and condensate audit
A Solid Partner for Steam and Condensate A

- Optimize Yankee differential pressure or blow-through rates
- Determine if the internal components are all functioning properly:
  - Gaskets
  - Collection pots
  - Headers
  - Risers
  - Straws
Detect Internal Deficiencies on the Run

Sheet too wide for grooves

Blocked straw

Flooded groove
Establish Best System Performance

Use IR imaging to establish the best S&C KPI settings for the optimum Yankee thermal performance.

Now use on-line system to maintain resilient Yankee performance in real-time.
Taking the Audit On-line

Step 1.
Aggregate data from multiple sources

DCS/historian
QCS
Paper Lab/LIMS
Blade Vibration

Step 2.
Add domain expertise
Calculate KPI

Calculation Engine

Step 3.
Visualize indexed KPI data

Steam and Condensate Unit
Unit Score 67.76 %
Slow-through Ratio

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Example: Steam and Condensate Scorecard
How Does It Work?

J Curve Data Input

- Differential pressure
- Motive steam flow
- Blow-through flow

For example: Let's look at the 'blow-through: supply steam ratio', a critical parameter of the J curve.
Indexing the KPI

- We can take a calculated KPI value, in this case BT: Supply steam ratio and compare it with best practice: 0.4 in this case.

- From the deviation from best practice, we calculate and index where 100% always = good.

In our example, we deviate from the preferred 0.4 ratio, so we show an indexed value of 67%.
Weight and Aggregate the KPI

• We can weight and aggregate all KPI for the unit operation into a score for the whole unit op. Again 100% =

• A trend display is available for each KPI as well as the whole unit operation
Aggregate the Unit Ops for a Complete System
Summary

- A straightforward Yankee steam and condensate audit focused on specific KPI can help set up the best performance

- Fine tune or troubleshoot this with precision IR imaging

- Transfer the KPI monitoring to a real time on-line Yankee diagnostics system for sustainable performance and troubleshooting
  - A small, modular, impactful step on the journey to Industry 4.0