Advanced Solutions

Honeywell

Whitepaper

Our Experience with Mill Wide Process Control Performance Monitoring

Executive Summary

In many mills, the ratio of control assets to engineers is greater than 300 to 1, which often means a complaint-driven or failure-based maintenance model is the norm. Due to this work overload, many control issues are seen as tuning related and are often addressed in this manor or overlooked completely.

This paper presents an overview of a condition based maintenance approach to control performance monitoring. This approach is looking at the three fundamental aspects of asset optimization:

- utilization
- performance
- sustainability

A case study with industrial results is presented to illustrate the concepts and benefits of continuous monitoring and condition-based maintenance.

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Current Maintenance Approaches

Today, a world scale pulp and paper mill can have up to 2,000 regulatory control loops. With maintenance and engineering personnel far outnumbered by these assets, loops believed to be critical typically receive priority while others are treated in a 'run to failure' mode. Correctly diagnosing control problems and setting maintenance priorities to deal with these assets is a far greater challenge. Studies in several industries have shown that between 40 and 80 per cent of regulatory controls in process plants are functioning sub-optimally. (Shook et al [1], Cox et al [2])

New monitoring techniques, however, have prompted some organizations to pursue a condition based maintenance paradigm. To further demonstrate the benefits documented in the paper, "Cost Savings Achieved through Control Loop Assessment Technology" (Mitchell et all [3]), this paper outlines the need for technology to properly diagnose the underperforming asset before scarce resources blindly apply incorrect maintenance. Monitoring and analysis of control assets are central to condition-based maintenance. By automatically identifying and reporting on performance, maintenance can be directed to loops with the greatest negative impact on performance, allowing maximum benefit to be derived from the application of maintenance resources and saving the expense of unnecessary maintenance.

The New Paradigm: Continuous Monitoring and Condition-Based Maintenance

With throughput goals on the rise, and fixed cost reduction more important than ever, a better maintenance approach is required for pulp and paper companies to survive in today's market place. Technology is playing a more important role in this changing environment, by proactively monitoring all the control assets and notifying personnel of only the poorly performing assets and their maintenance issues.

Control Performance Monitor

Control Performance Monitor is a control asset management solution that addresses the maintenance and support issues that surround control assets in a process environment. Control Performance Monitor is Powered by Matrikon, which represents vendor neutrality. This product works with third-party control systems and applications. Control Performance Monitor provides an automated means of assessing and monitoring the performance of all of the assets in the control hierarchy up to and including the advanced control layer. The application is targeted at improving control performance while simultaneously lowering the long-term cost of sustaining the performance of control assets across an organization.

Control Performance Monitor was designed to integrate with existing plant maintenance business processes, providing all interested parties with the information they need to carry out specific job functions in the control maintenance work processes. It is flexible enough to handle a wide variety of configured controller types and control objectives and integrates well with alarm and event archives such as Alarm Manager. The application is compatible with all commercial DCS and data historians.

Case Study: Abitibi-Consolidated, Beaupre, Quebec

Business Situation

Abitibi-Consolidated is a global leader in newsprint and uncoated ground wood papers with ownership interests in 27 paper mills in Canada, the United States, the United Kingdom and Asia, and in 22 sawmills, 3 remanufacturing facilities and 10 recycling centers. Their pulp and paper mill in Beaupre, Quebec, produces ground wood specialty papers up to 83 ISO brightness. They produce 214,000 MT of value added paper annually, and staff their operation with 420 employees.

A corporate-wide Continuous Improvement (CI) focus provided the impetus for exploring new strategies to reduce variability, develop a more proactive approach to maintenance and increase the return realized from production assets. Control Performance Monitor software was implemented mill wide on 500 control loops to provide continuous monitoring and diagnostics.

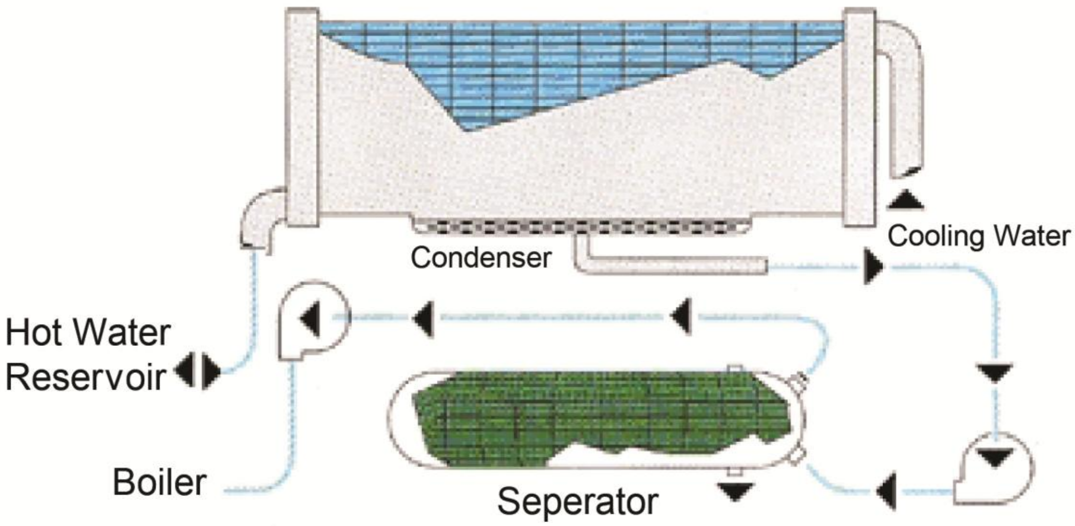

Figure 1 - Process Graphic of the #1 Paper Machine Condenser

Identifying Under Performing Controllers

Abitibi staff began using the tool immediately by letting Control Performance Monitor proactively notify them on loops with poor health. Within the first few weeks of running Control Performance Monitor, the #1 paper machine condenser circuit was identified as underperforming. Maintenance staff directed their efforts to address this pressure controller saturation problem.

Controller PIC-1308 controls the flow of cooling water to the #1 drying room condenser (figure 1). Control Performance Monitor analysis reports were showing very low utilization for this loop, the controller being saturated almost all the time (figure 2). In addition, performance indexes showed poor performance and oscillations during the brief periods it was out of saturation (figure 3).

Problem Identification

This controller was tuned in 2001 as part of an improvement project in that process area. Along with tuning, the control strategy was designed to ensure a constant pressure drop between the condenser and the drying area. With time, performance improvement in the drying area along with production increases lead to a pressure set point below what was physically achievable in the condenser and thus to a saturated controller.

As this controller was of less importance compared to other control problems, it was not detected prior to the establishment of a continuous monitoring methodology

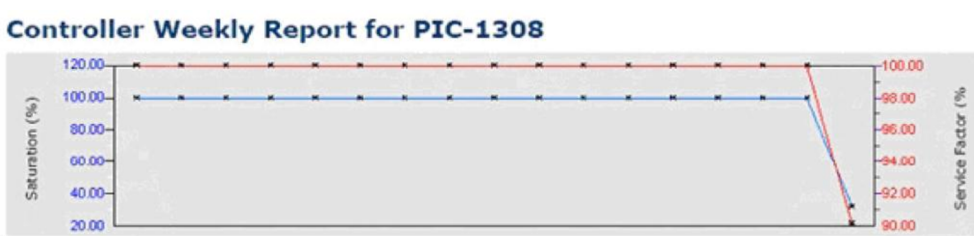

Figure 2 - Control Performance Monitor reports showing 100% saturation (blue line) for 16 out of 17 days.

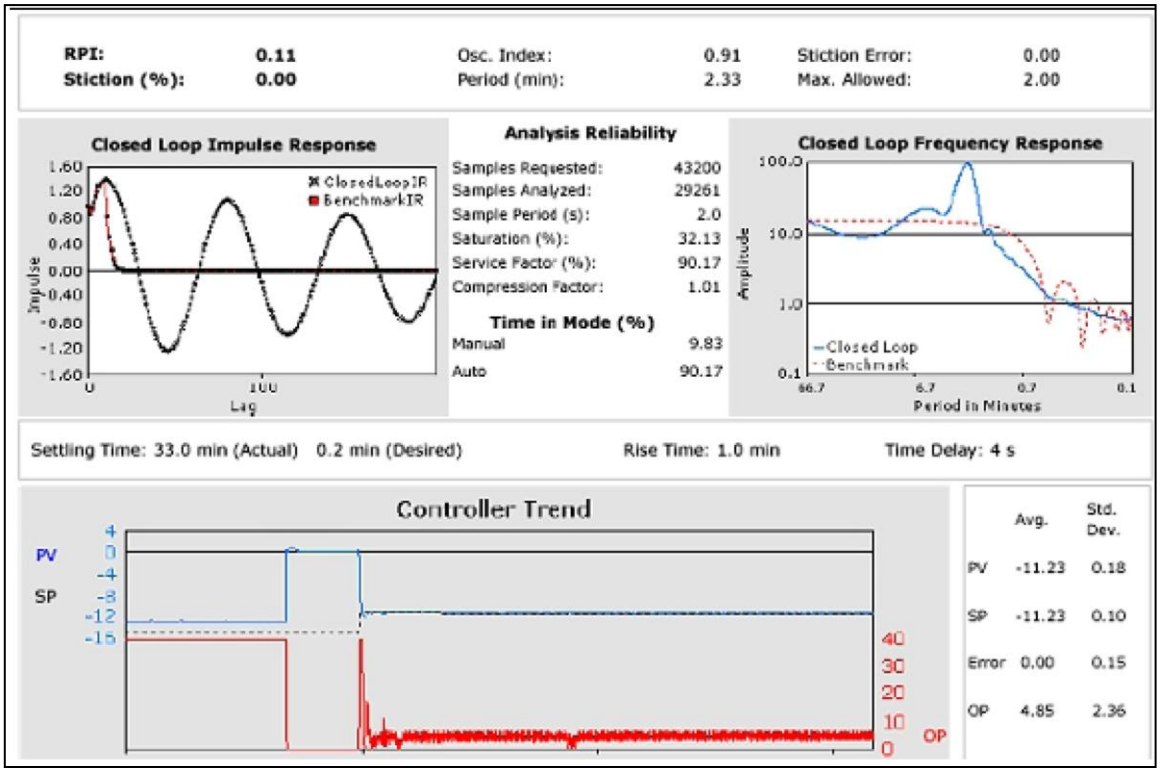

Figure 3 - Loop Analysis Report for the #1 condenser controllers before controller redesign

Review of the Control Strategy

Once Control Performance Monitor proactively notify engineers of the problem, it was very easy for the automation team to reassess the strategy and modify the pressure drop bias to a more reasonable value in accordance to the actual plant production. They also took the opportunity to improve loop performance by adding other plant situations causing saturation and improve the strategy accordingly to reduce further cold-water usage in the condenser.

One can ask why was it a problem, if the saturated controller was not causing upsets important enough to be noticed by operations. The condenser cooling water is recovered in the hot water tank where steam addition controls the temperature. Any excess cold water going in that tank uses extra steam; and steam is money.

The result of readjusting the strategy was thus a dramatic reduction in steam consumption and a control loop that remains in stable automatic control.

Results

Figure 3 illustrates a typical loop analysis report before controller redesign. Acting only when going in and out of saturation, the controller performance showed bad closed loop disturbance rejection capabilities and high oscillations. Controller performance indicators before changes:

- low relative performance index (RPI) <.2
- high oscillation index 0.9 (max 1)
- poor settling time at 33 minutes

Figure 4 shows the performance of the loop after the control redesign and tuning validation were applied which greatly improved the performance of the loop.

Controller performance indicators after changes:

- increased loop performance from 0.2 RPI to close to 1.0 RPI (on specification)
- decreased settling time from 30 minutes to 10 minutes without oscillation
- control loop remains in stable automatic control
- decreased steam demand by 2400 lbs/hr on average

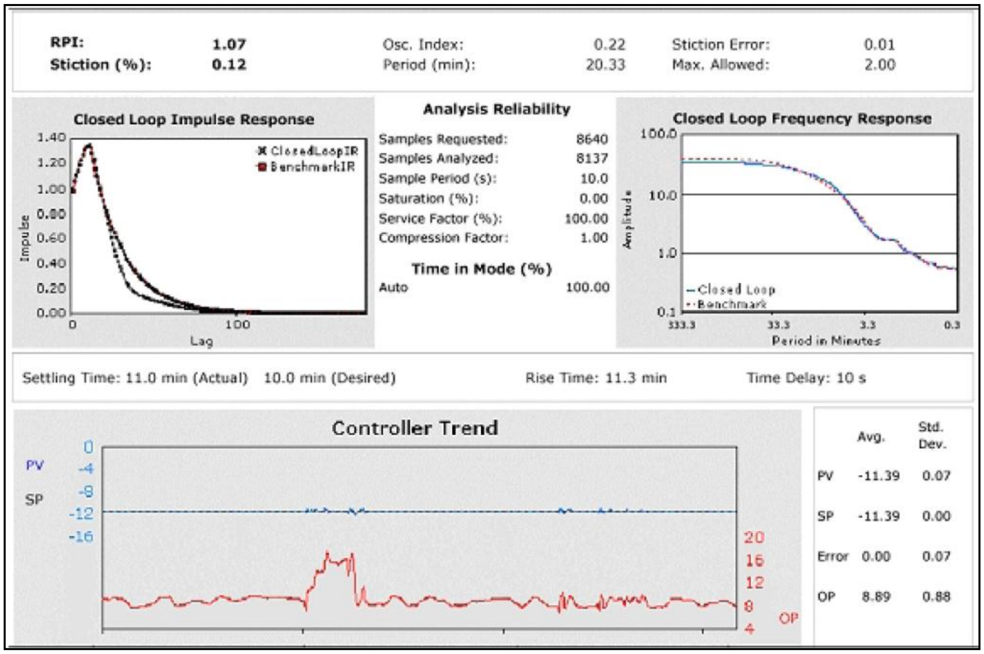

Figure 4 - Loop Analysis Report for the #1 condenser controllers after control redesign

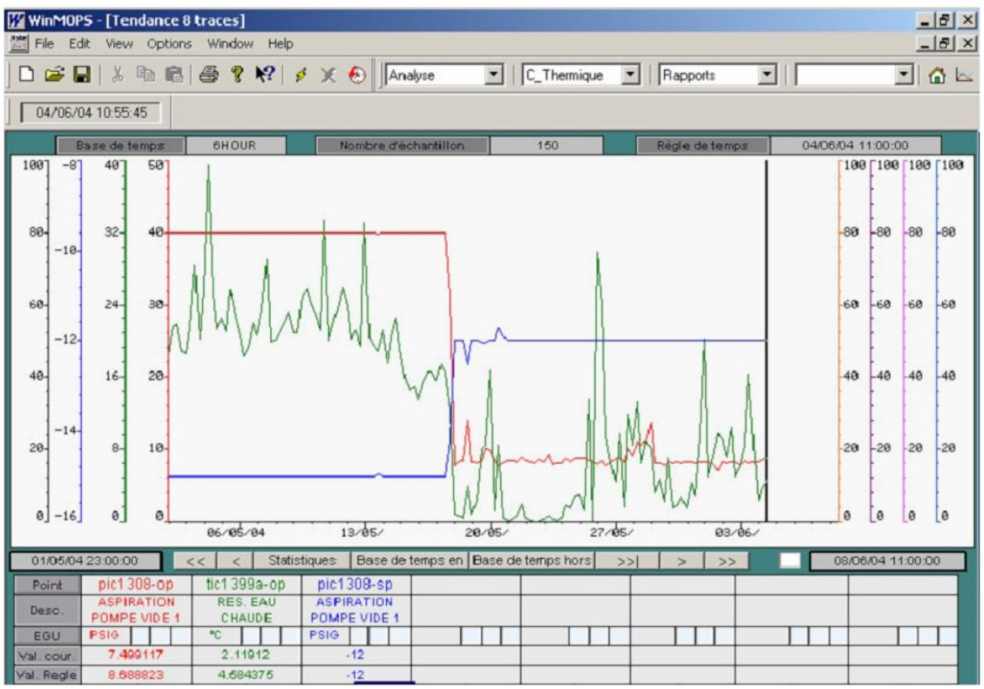

Figure 5 - TIC1399 output (green) decrease can be directly related to steam production cost savings.

The four months prior to diagnosing the problem with Control Performance Monitor, the #1 paper machine condenser average hourly steam consumption was 5000 lbs. For the four months following the modification of the strategy, the average hourly steam loss was reduced to 2600 lbs, representing a cost savings of close to $150,000 annually. The savings achieved from the #1 condenser alone provided an excellent return on investment for the entire Control Performance Monitor project.

Figure 5 illustrates the drastic change in the steam addition loop (TIC1399a-op) represented by the green line. This control strategy redesign has reduced the travel on the steam addition valve by 20% and allowed the Beaupre mill to sustain this new performance.

Control Performance Monitor monthly summary reports (figure 6) indicates sustainability of the changes, as the RPI values are consistently around 1.0 showing that the loop is still performing according to its specifications.

This example shows that even a minor loop such as this one can provide substantial savings if control performance problems are properly diagnosed first and the proper maintenance applied.

With Control Performance Monitor, engineers are continually being notified of underperforming assets through continuous monitoring which has provided benefits in focusing scarce resources on underperforming control assets.

Monthly Summary for SECHERIE MP1

Relative Performance Index (Monthly)	Dec	Nov	Oct	Sep	Aug	Jul	Jun	May	Apr	Mar	Feb
LIC-1321	1.19	1.43	2.09	2.43	2.44	2.51	2.45	2.43	1.42	2.45	4.58
LIC-1322	2.14	2.06	1.96	2.16	2.11	2.13	2.17	2.16	1.95	6.21	6.59
LIC-1323	2.32	2.26	2.05	2.07	2.03	1.94	1.82	2.04	1.93	3.18	3.74
LIC-1324	1.58	2.54	2.21	1.90	1.30	1.38	1.08	0.94	2.02	2.13	4.02
MM1HUM	3.92	1.80	1.65	1.49	1.96	1.81	2.05	1.97	2.01	1.44	1.42
MM1HUMSN1											
PDIC-1315	1.25	0.94	0.81	0.71	1.39	1.25	1.02	0.98	0.70	0.34	0.16
PDIC-1318	0.92	1.10	0.89	1.07	1.08	1.11	1.02	1.06	1.03	0.34	0.20
PDIC-1325	2.05	2.31	2.09	2.25	2.42	2.27	2.06	2.34	2.61	0.68	0.34

Figure 6 -Control Performance Monitor monthly performance summary. PIC1318 performance is sustained after the April change.

Summary

The continuous monitoring capability provided by Control Performance Monitor at Abitibi’s Beaupre Mill provided control engineers and maintenance staff with a valuable tool in terms of improving their ability to do control maintenance proactively and for detecting process problems that had gone unnoticed during routine maintenance. In addition to improving plant performance, the use of Control Performance Monitor has helped staff at the Beaupre mill to move toward proactive maintenance work processes to maximize the effectiveness of available resources while reducing variability, improving product quality and preventing unplanned downtime.

Conclusion

This paper has examined a new approach to performance improvement through the use of technology to proactively monitor the condition of all the control assets in a pulp and paper mill.

Condition based maintenance look at all three aspects of optimal asset usage: utilization, performance and sustainability for proper identification of the maintenance needs first before scarce resources apply incorrect maintenance.

With the recent changes in the pulp and paper industry, adoption of condition based maintenance tools like Control Performance Monitor are imperative to meet improved performance and cost reduction goals.

The case study of Abitibi-Consolidated's Beaupre Mill describes one example of how Control Performance Monitor helped control engineers and maintenance personnel pursue a proactive, condition-based maintenance model for mill process control.

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[7] MITCHELL, W, "Cost Savings Achieved through Control Loop Assessment Technology", 1 - 9

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