Optimizing Glass Process Stability, Throughput with the PowerInsight by Advanced Energy™ IoT Solution

INDUSTRY	SOLUTION	EQUIPMENT
Glass Coating	PowerInsight by Advanced Energy™ Software	Ascent® AMS and DMS DC Power-Delivery Systems

INTRODUCTION

Lacking the ability to capture the full intricacies of the plasma system, a customer struggled to accurately characterize their process and troubleshoot deviations and interruptions. This study describes how the AE team incorporated the PowerInsight by Advanced Energy™ data acquisition and analysis platform to provide the insight required to identify the root cause and implement effective solutions.

CHALLENGE

Process Deviations and Interruptions

Frequent process deviations were disrupting a customer's silicon-stack glass-coating production line. This included cycle-time drifts, long-term drifts, and short-term issues. Because they lacked closed-loop control and alignment, every time operators observed a change in in-situ and ex-situ process-quality data, they manually changed the set points based on assumptions rather than real data. Continually compensating for the process drift in this way led to poor control and product quality. Further, the need to halt production to adjust parameters, as well as the subsequent ramp-up time, were causing delays and significantly decreasing throughput.

Inaccurate, Incomplete, and Low-Resolution Data

In addition to these process problems, low data availability and quality made it very difficult to understand exactly what was happening in the process. Production campaigns were calculated using kilowatt-hour counters, which didn't accurately reflect actual vacuum and plasma conditions in the compartment. Therefore, it was extremely challenging to determine exactly when maintenance was required. Venting the process "too soon" can increase cost due to target material waste. On the other hand, venting the process "too late" can cause unplanned downtime if target material is exhausted before processing stops.

Process engineers also were struggling with a data visualization tool that lacked the resolution and advanced analytics support they needed to characterize and troubleshoot the process. Because the data sample rate and aggregation weren't sufficient, they were missing critical information and analysis. This made it extremely challenging to address the root cause of the instability.

SOLUTION

A team of AE and customer personnel examined the issues and applied PowerInsight by Advanced Energy™ software, which expanded process, machine, and quality data along five key parameters:

- Visibility
- Resolution
- Accuracy
- Aggregation
- Analysis

The PowerInsight by Advanced Energy platform collected and examined large data sets from multiple targets over multiple campaigns to "learn" start and end conditions along with degradation rates over time. Flexible data collection rates enabled the team to zoom in on the level of detail they needed, while user-specific dashboards provided easy-to-use, custom views that conveyed real-time, high-resolution data and process trends. This enabled the team to:

- Identify short-term process issues.
- Fingerprint the process (set points/configurations).
- Compare existing (1 Hz) data with PowerInsight high-resolution (up to 10 Hz) stabilization to reveal deviations, issues, and trends.
- Identify the root cause of process deviations.

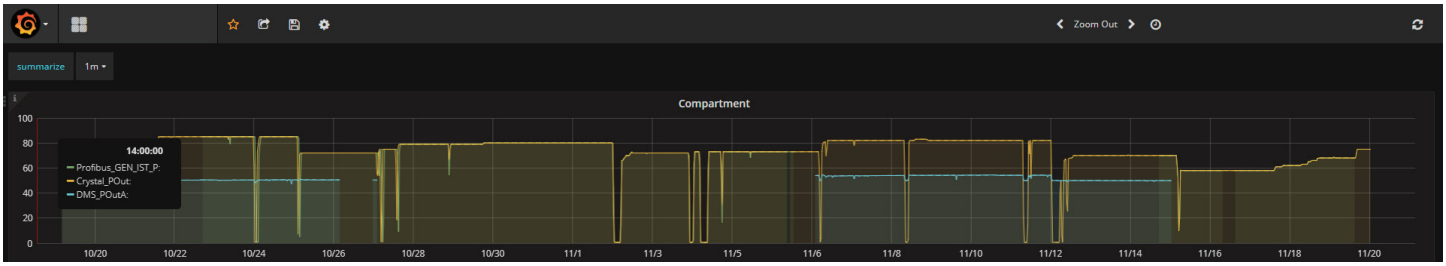

Figure 1. PowerInsight by Advanced Energy data viewer

Increased Uptime and Decreased Material Cost

PowerInsight by Advanced Energy software replaced the existing kilowatt-hour counter method with real-time impedance measurement to reflect actual vacuum and plasma conditions in the compartments. Using that method, plus additional sensor data, the team observed that impedance dropped at the end of the production campaign. Because impedance typically decreases gradually as the target is consumed, they could more precisely characterize the process and predict target-material consumption. Using PowerInsight data and analysis, they were able to estimate remaining target life and accurately calculate the best timing for target replacement. Ensuring maximum target life helped reduce material cost, while precise maintenance scheduling guarded against unplanned downtime if target material was exhausted before planned maintenance.

Predictive maintenance cycle accuracy reduced material costs and unscheduled downtime.

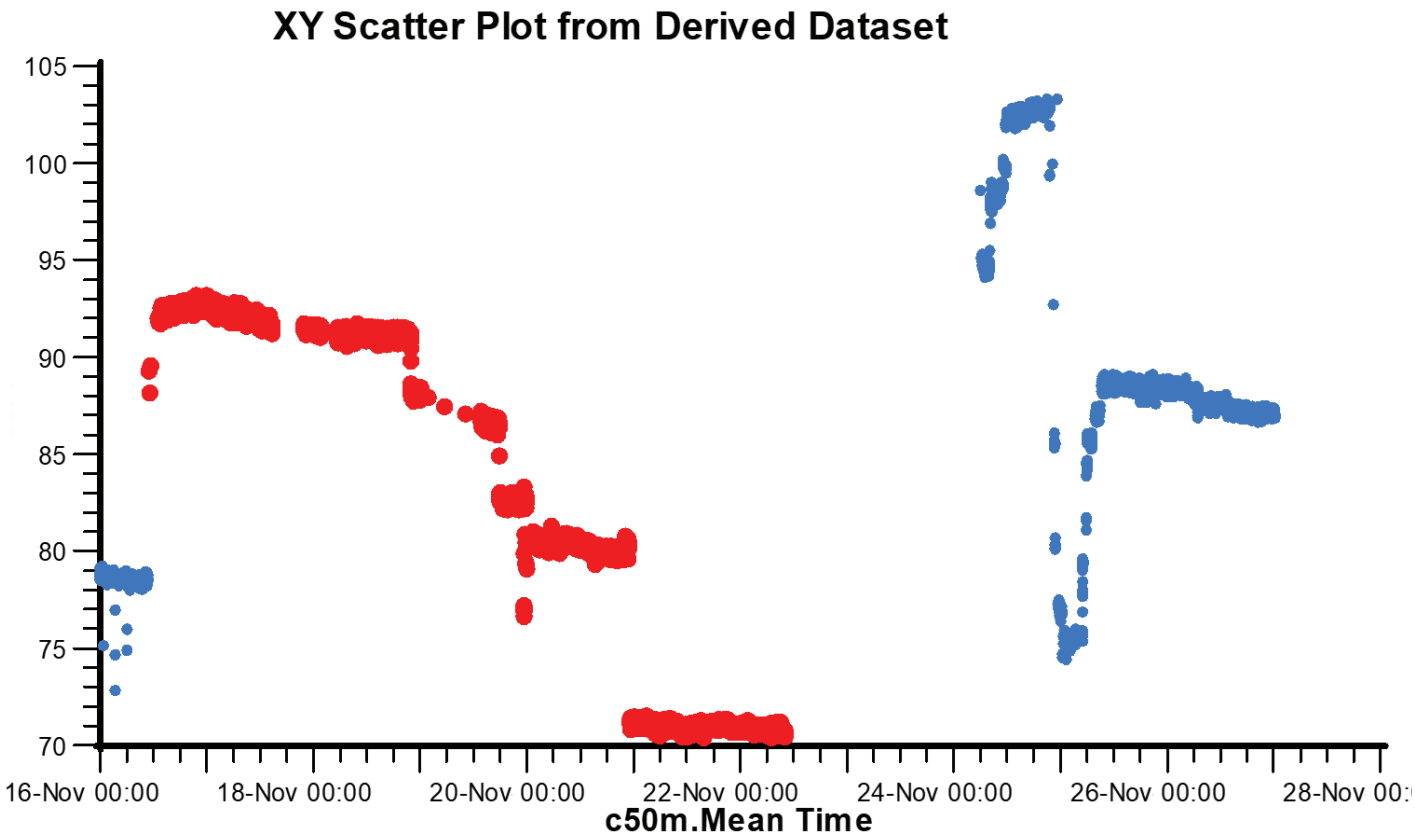

Figure 2. PowerInsight by Advanced Energy™ data analysis revealed a drop in impedance at the end of the production campaign (red)

Optimized Process Stability, Throughput, and Product Quality

Real-time impedance calculation also enabled the team to identify a solution for process deviations: align power-supply set points with actual compartment conditions. Aggregating all available process data within the PowerInsight by Advanced Energy platform enabled it to deliver a “HealthCheck” signal (“ok/not ok”) on an ongoing basis, as well as parameter information about deviations. The customer used this information to implement closed-loop control and align set points (process biasing) with actual compartment conditions over the long term. Optimizing these power-supply settings stabilized the process to maximize throughput and quality.

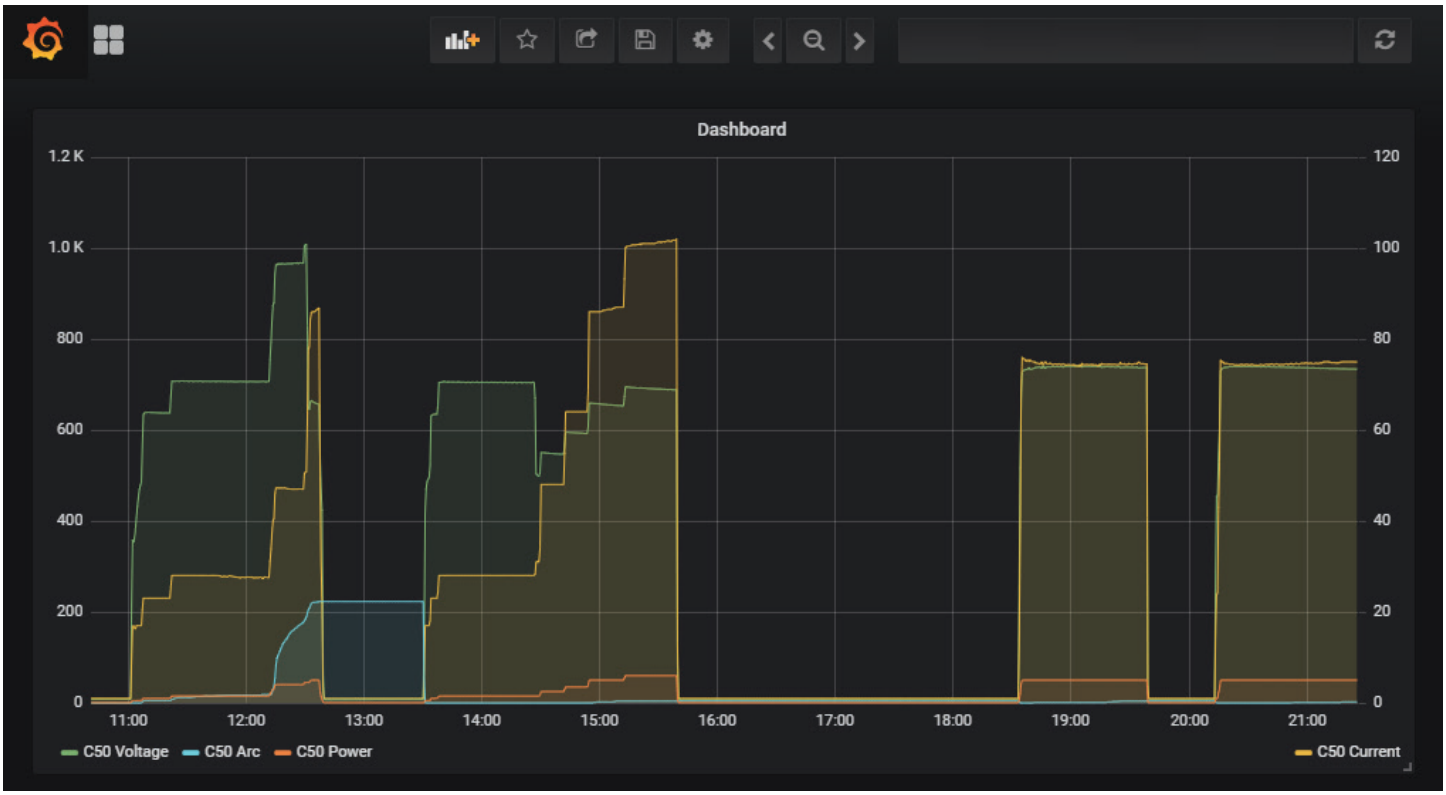

Figure 3. Typical PowerInsight by Advanced Energy™ dashboard showing arc count, voltage, current, and power

The PowerInsight platform also provided visibility into process conditions during the burn-in cycle ramp times. Note the two instances in Figure 3, above, of power "walkup" (orange) between 1100 and 1600 h and the resulting arcing (blue). Faster power ramp between 1100 and 1300 h resulted in arcing. Slower power ramp between 1330 and 1600 h resulted in a noticeable reduction in arcs. The dashboard also recorded a current "swing" when power was increased at the start of the campaign. This data enabled the team to determine that power was being increased too fast; slowing down the ramp-up time during the condition cycle reduced arc rates, stabilized current, and improved process stability.

RESULT

The ability of the PowerInsight by Advanced Energy platform to expand data visibility and analysis had comprehensive effects on key measures of process success, including cost, throughput, and product quality. Actionable intelligence enabled operators to make decisions driven by data rather than assumptions, proactively solving root cause rather than reacting to issues in the moment. The result was demonstrated improvements to both product quality and the bottom line.

CONCLUSION

The PowerInsight by Advanced Energy IoT solution brings actionable intelligence to critical processes, providing new levels of data visibility, insight, and analysis. More than just a troubleshooting tool, it's a window into process performance, providing a comprehensive understanding of actual conditions in the plasma system in real time.

With this unique knowledge, PowerInsight users can pinpoint ways to resolve existing issues and visualize previously unidentified optimization opportunities over the long term.

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