Brochure

Aspen Batch APC™

Achieve consistent product quality and push the process to new limits

Overview

Aspen Batch APC™ (Advanced Process Control) is a closed-loop, model-predictive batch control system that improves product quality and yield, and lowers cycle times. It features a built-in optimization engine that predicts end-of-batch quality attributes at key decision points along the batch process. By automatically adjusting a batch recipe at these decision points, Aspen Batch APC minimizes off-spec products, maximizes efficiencies, and reduces the need for manual oversight by operators. Aspen Batch APC enables manufacturers to improve process stability and product consistency for higher margins with a solution specifically designed for batch processes.

Aspen Batch APC's unique capability to provide a predictive model that, when implemented in closed loop, results in improved process stability and performance. In **closed-loop** implementation, the system has the ability to self-correct based on process feedback. Without closed-loop implementation, operators must manage a range of complex process interactions manually.

Challenges

It's difficult to control the quality of the final product.

Batch processes, like those used in specialty chemicals operations, consumer packaged goods etc., are complex operations that are typically run in open loop. Operators must monitor and manage a range of complicating factors, including temperatures, pH, pressures, flow rates, raw material properties, and variations in the batch recipe itself.

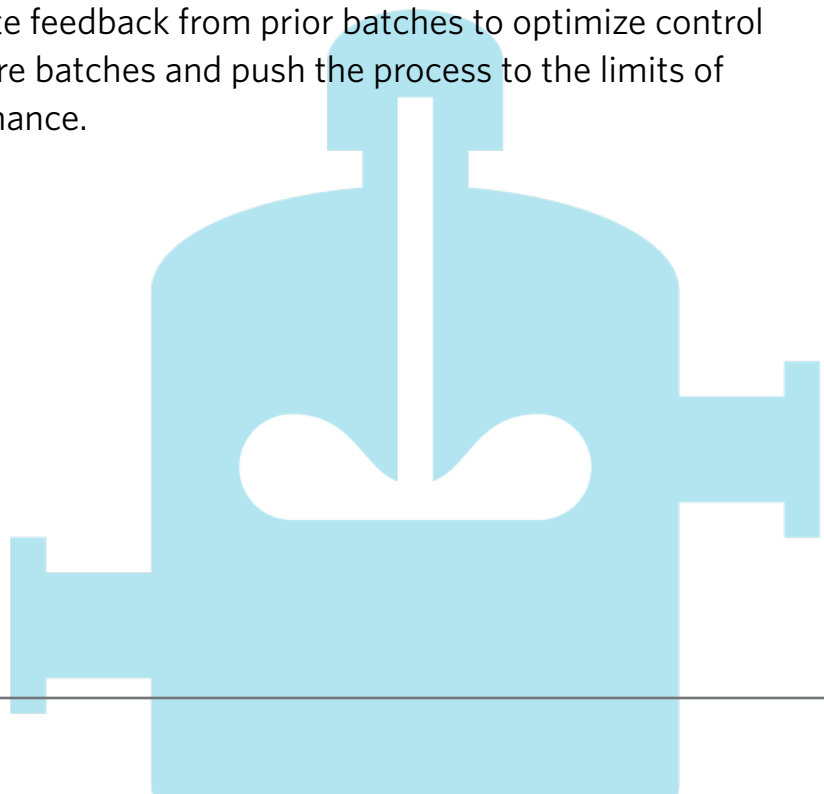
These variations make it difficult to deliver consistent quality in the final product.

Even those batches whose product is within specifications almost always exhibit some variability in product properties due to the natural propagation of the disturbances through to the final product.

Solution

Solution: *Aspen Batch APC directly addresses the dynamic, nonlinear nature of batch processes as well as the impact of disturbances on end-of-batch outcomes.*

- Closed-loop, automatic optimization engine makes course corrections to batch recipe at key decision points—based on predictions of final outcomes for quality, yield and cycle times.
- Significantly lower the cost of poor quality (COPQ) and minimize off-spec batches by compensating for variations in raw materials, equipment operations, ambient conditions and more.
- Integrate feedback from prior batches to optimize control for future batches and push the process to the limits of performance.



Aspen Batch APC provides closed-loop, model-predictive feed-forward/feedback control capability that is specifically designed for batch processes.

Challenges

Manual process control introduces variability in the end results and also requires significant time commitment from dedicated operational resources

While the pandemic is easing in many parts of the world, many plants continue to operate with a reduced staff overall and fewer dedicated workers available to oversee production.

Moreover, manual control requires skilled operators to constantly monitor and tweak the process when their expertise could be put to better use elsewhere.

Solution

Solution: *Aspen Batch APC reduces the need for human oversight with a closed-loop system that automatically optimizes the batch process.*

- A single software solution minimizes the human variables in the production process, delivering a more consistent end product.
- Lowers operator time commitment.
- Supports a remote workforce.
- Outperforms manual intervention, 24/7.

Challenges	Solution
Production capacity is limited and facility upgrades are costly. Plants can miss revenue opportunities when demand exceeds existing production capacity. Moreover, rush orders or inventory requirements may increase costs. Building new production lines or plants to increase capacity requires large capital expenditures.	**Solution:** *Aspen Batch APC increases production capacity without the need for large capital outlays.* • Closed-loop, optimized adjustments to the batch recipe boosts production by minimizing off-spec product and the need to discard it. • Shorter cycle times and higher yields increase production efficiency and boost capacity.
Raw materials are costly and low conversion rates may reduce margins. The cost of raw materials has a significant impact on overall production costs. When batch processes aren't tightly controlled, expensive and hard to obtain raw materials may have low conversion rates to final product, resulting in waste or the need to recycle—further driving up costs.	**Solution:** *Aspen Batch APC improves conversion and increases product yield.* • Closed-loop, optimized adjustments to batch recipe, at key decision points, based on predictions of yield. • Integrate feedback from prior batches to optimize control targets for future batches to maximize conversion and minimize waste or unnecessary recycling of raw materials.

At key decision points during batch evolution, the **Aspen Batch APC** model predicts end-of-batch outcomes and takes control actions if predicted outcomes are outside target regions.

How Aspen Batch APC Works

Aspen Batch APC models are multivariate empirical models that are built using Partial Least Squares (PLS) method to model end of batch outcomes such as final product quality.

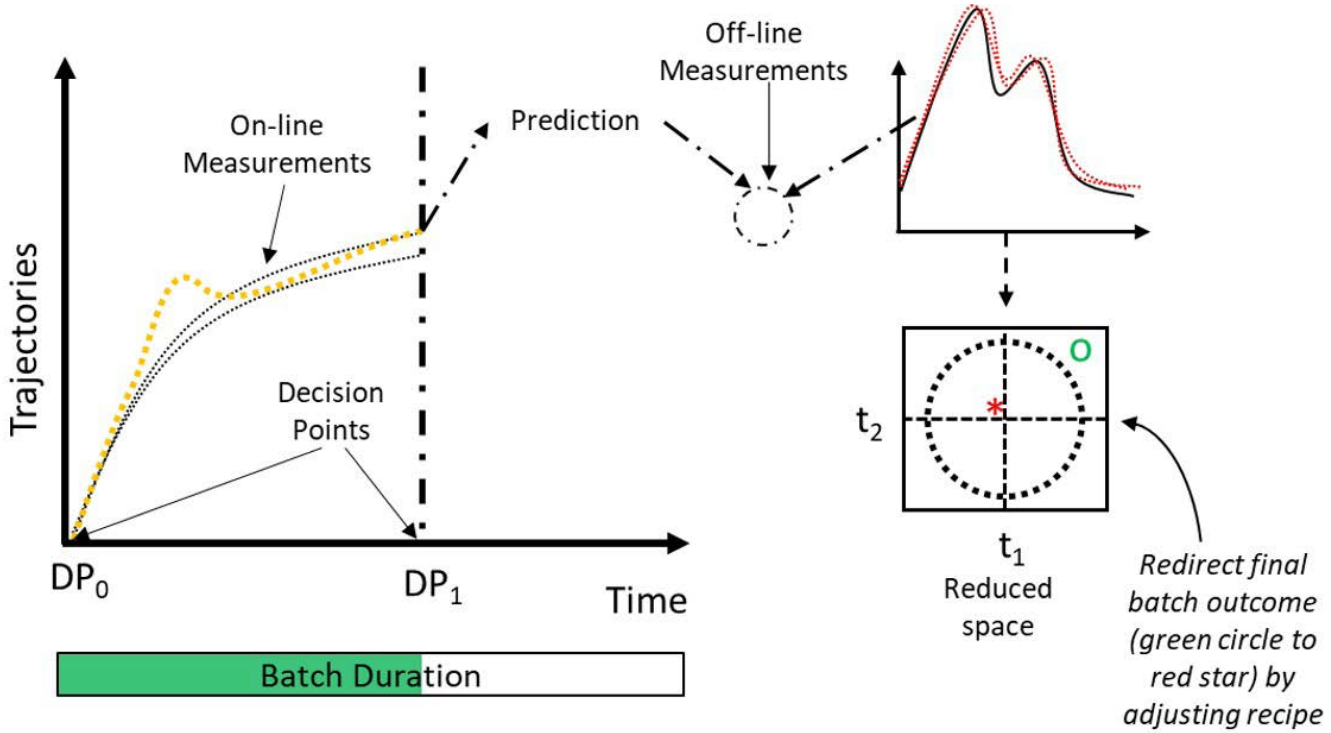


Figure 1: Batch-specific Model Predictive Control

At key decision points **(see Figure 1**) during batch evolution, the Aspen Batch APC model predicts end-of-batch quality attributes and takes control actions found via an optimization algorithm that proactively adjusts the default batch recipe if predicted outcomes are outside target regions.

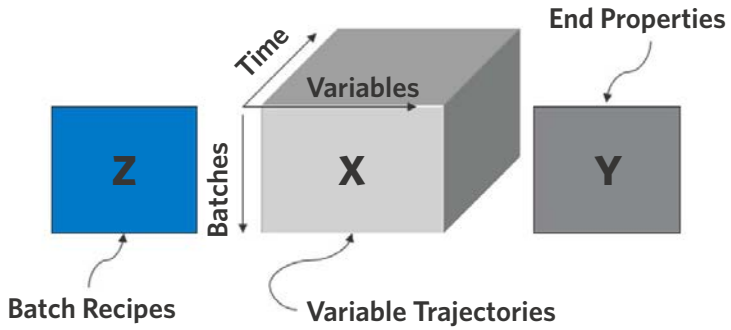


Figure 2: Partial Least Squares (PLS) Model Structure

This system incorporates all of the initial conditions on each batch (e.g., batch charges, raw material properties, etc.), and all of the time varying trajectory data up to critical decision points in order to adjust the set-points of the lower-level controllers (e.g. flow rates, temperatures, energy input, etc.), or key recipe inputs (such as amount to charge of a specific ingredient).

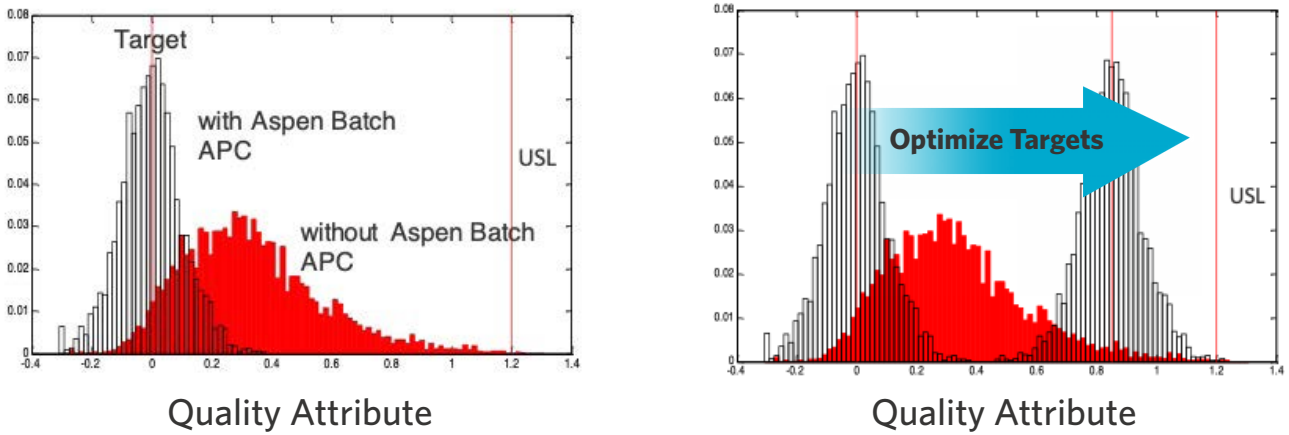


Figure 3: Distribution of Product Quality Attributes Before and After Batch APC Implementation

The histograms in figure 3 show the distribution of one of the product quality attributes before and after the implementation of Batch APC.

As a result of reducing the variation in the quality attributes and controlling them reliably around their set points, it becomes possible to move the set points to a region where both the overall quality of the product and the productivity of the batches are much better.

In the face of disturbances, such as variations in raw material quality, ambient and equipment conditions, etc., Aspen Batch APC makes optimized corrections to the batch recipe and steers the batch trajectory so that outcome for final product quality, yield and batch cycle time is as close to target as possible. This approach is depicted conceptually in **Figure 1** (see page 6) and **Figure 2** (see page 7).

In technical terms, Aspen Batch APC solves a numerical optimization problem at each decision point to optimize a performance index, subject to constraints. The optimizer solves for the process set-points (manipulated variables) that are predicted to achieve the end-of-batch targets such as quality, yield, etc., as closely as possible, while obeying the constraints.

The optimal values of the process set-points are then implemented in the plant, and the batch is operated using those set-points until the next decision point is reached. This is effectively a real-time optimal adjustment of the "standard batch recipe" to correct for the specific disturbances affecting the current batch. This approach is repeated, potentially with different optimization criteria at each decision point, until the batch is completed.

Expected Benefits of Aspen Batch APC

Increase production margins significantly

- Improve product quality
- Reduce off-spec product and waste
- Optimize the conversion of raw materials
- Boost overall production capacity without the need for capital outlays

Boost operational staff productivity

- Lower the time required for operator oversight
- Make better strategic use of skilled operators' time
- Outperform the collective brainpower of the most skilled operators, 24/7

Achieve higher rates of customer satisfaction

- Deliver more consistent product that meets specifications
- Increase production capacity to meet spikes in demand

Conclusion

Aspen Batch APC significantly reduces variation of product quality while optimizing cycle time and yield in batch process plants. This automated, closed-loop control capability frees operators to focus on preventative maintenance and other value-add tasks, further boosting productivity. By delivering greater efficiencies and more consistent product—without the need for large capital outlays—Aspen Batch APC is the clear choice for manufacturers seeking to boost batch process stability and production margins.

About Aspen Technology

Aspen Technology (AspenTech) is a leading software supplier for optimizing asset performance. Our products thrive in complex, industrial environments where it is critical to optimize the asset design, operation and maintenance lifecycle. AspenTech uniquely combines decades of process modeling expertise with machine learning. Our purpose-built software platform automates knowledge work and builds sustainable competitive advantage by delivering high returns over the entire asset lifecycle. As a result, companies in capital-intensive industries can maximize uptime and push the limits of performance, running their assets safer, greener, longer and faster.

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