Adaptable Automation Using State-Based Control

An edible oil processing company struggled to run various products with unique characteristics until they applied state-based control loop performance monitoring software to handle the differences.

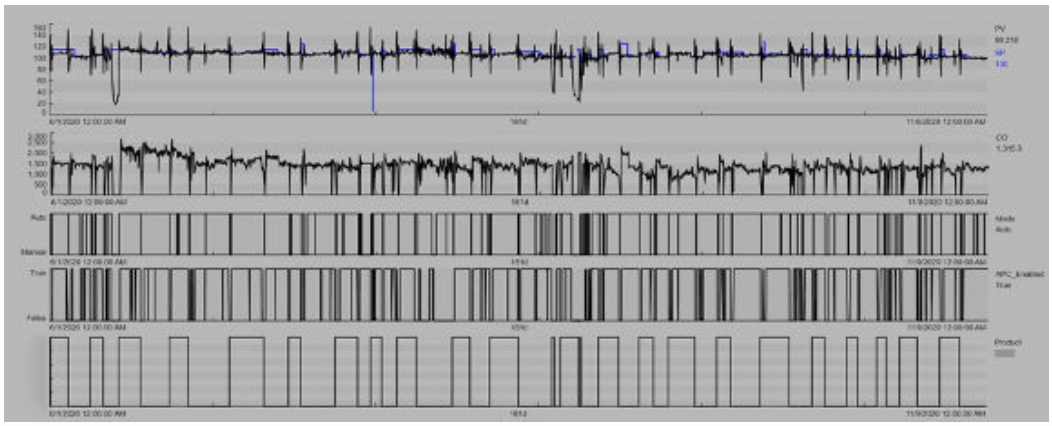
Good automation system designs are built to detect and compensate for many operating conditions. However, one food and beverage manufacturer simply couldn't tune their equipment adequately when processing different types of edible oils due to unique product characteristics that dramatically affected loop tuning requirements. In an article we wrote for Food Engineering June 2023, titled State-Based Control Uncovers Automation Gains, we discuss how many manufacturing and processing operations with similar issues can benefit from applying state-based analytics to recognize and adapt to drastically different conditions.

Manual to automatic

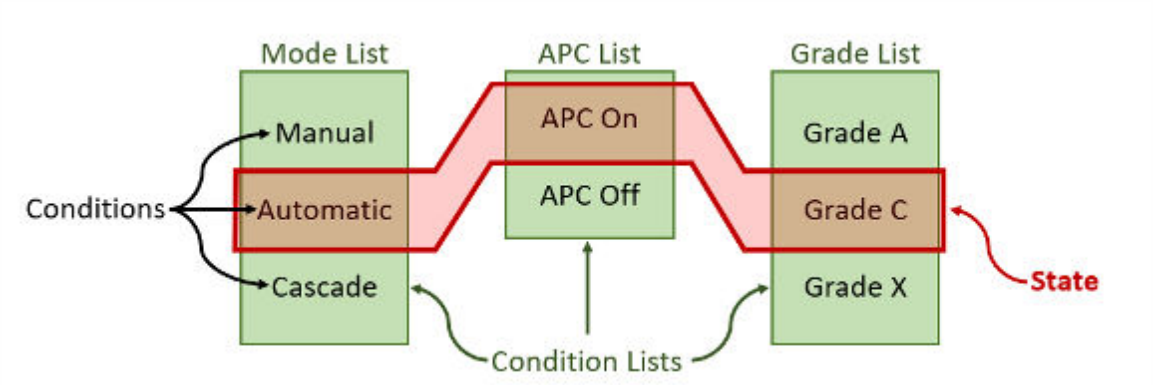
The process previously relied on manual efforts to maintain control during production changes. Operators adjusted controller settings based on experience, aiming to match conditions for different product runs. This often led to inconsistencies and inefficiencies—such as overuse of materials or timing issues with lab testing. Although advanced control methods like MPC were introduced, they still struggled to deliver consistent improvements due to unseen variations between operating conditions. Without a clear understanding of how loop performance shifted between states, the facility was limited in how much it could automate. A more adaptive approach was needed to drive meaningful, measurable gains.

State-based solution

Rather than treating loop performance as a single, averaged behavior, the new solution provided visibility into how controllers performed across distinct operating states. With state-based analytics, the facility could automatically recognize conditions like warm-up, steady production, or changeovers, and evaluate loop behavior within each. This level of insight revealed tuning issues that had previously gone unnoticed and allowed for precise, state-specific adjustments. The result was improved consistency, reduced reliance on manual testing, and better use of advanced control like MPC. The success of this approach quickly led to its expansion, helping standardize control strategies across additional loops and production sites.



The team was already familiar with using Control Station PlantESP control loop performance monitoring (CLPM) software for tuning individual loops in a given state, such as running Product “A” or “B”. But if the analysis is performed across runs of different states—in this case different products—then the CLPM software operates on averages which will mask details, so it will not optimize performance for either state.



Fortunately, Control Station PlantESP CLPM software includes the capability to identify and distinguish different operating states, and to perform analysis on a per-state basis. These state-based analytics enable users to define many unique operating conditions so that analysis and optimization activities can be tailored to specific scenarios.

Plant personnel just informed the CLPM software about which product was running, a simple task. Once this information was entered, the CLPM software calculated optimal PID tuning parameters, which were then applied in real-time with the MPC system. Control Station PlantESP enabled the oil processing facility to obtain an accurate performance assessment and optimize production for each product type.

State-Based Results (Collapsed)

Name	ESP_Mode	Average Absolute Error	Output Travel Per Hour
TC (Temperature)	Auto	3.11	3.15

State-Based Results (Expanded Along Grade)

Name	ESP_Mode	Product	Percent Time In State	Average Absolute Error	Output Travel Per Hour
TC (Temperature)	Auto	Grade C	52%	3.47	3.49
		Grade A	48%	2.72	2.8

State-Based Results (Expanded Along APC Status)

Name	ESP_Mode	APC Enabled	Percent Time In State	Average Absolute Error	Output Travel Per Hour
TC (Temperature)	Auto	Off	66%	4.85	5.9
	Auto	On	34%	2.21	1.74

State-Based Results (Fully Expanded)

Name	ESP_Mode	Product	APC Enabled	Percent Time In State	Average Absolute Error	Output Travel Per Hour
TC (Temperature)	Auto	Grade C	Off	19%	4.9	5.99
			On	33%	2.65	2.05
	Auto	Grade A	Off	15%	4.79	5.8
			On	33%	1.77	1.43

Operators, engineers and managers now have clear visibility into how the plant is running. Some of the metrics delivered by the CLPM software have entered into the operational dialog, and those metrics provide clarity among workers as they communicate during shift and plant changes.

This company has since used Control Station software to improve the operation of many other PID loops, at this facility and across more than 100 other sites globally. Analytics on their own don't fix anything, but putting powerful tools like PlantESP into the hands of users enables them to use analytics results effectively.

The team at Control Station is happy to discuss how CLPM and state-based analytics can be applied to help with your applications. Contact us today!