Multivariate Statistical Analysis Finds Cause of Quench Oil High-Viscosity Issue

aspentech | Case Study

Within just a few weeks, Aspen ProMV™ revealed which variables were causing high quench oil viscosity.

CHALLENGE

Since mid-2017, the company had been dealing with a quench oil high-viscosity issue at the PreFac distillation column.

SOLUTION

An Aspen ProMV Desktop standard (continuous) model was developed, and the bad actors were identified.

BENEFITS

This application proved that Aspen ProMV can understand and resolve production problems faster to limit the losses. Aspen ProMV enabled the company to:

- Highlight the top process variables highly correlated with viscosity issues
- Guide process engineers to the real issue with missing details of LCO characteristic data
- Look at how process variables from previous days affected outcomes
- Enable what-if analysis of the output using the Aspen ProMV optimizer

Overview

The customer organization is one of the largest chemical, plastic and refining companies in the world.

This company had been experiencing a quench oil high-viscosity issue over the past year and was unable to determine the cause. They needed to slow down production whenever this issue occurred, and it also reduced the effectiveness of the energy recycling process.

This company is a long-time user of AspenTech Manufacturing & Supply Chain and Engineering products. With this particular project, the goal was to:

- Demonstrate the Aspen ProMV methodology (show how the solution is able to highlight the key variables that correlate to the quench oil high-viscosity issue)
- Demonstrate the ease-of-use of the Aspen ProMV methodology

Investigating the Issue

The quench oil high-viscosity issue was causing lower heat removal in the quench oil loop and could result in plant shutdown.

Within the past couple of years, the company had changed light cycle oil (LCO) vendors, resulting in a different LCO composition. The function of LCO is to reduce viscosity in quench oil, but the company suspected that some types of LCO are actually not effective at all, causing the high-viscosity issue.

Data for this analysis included:

- Feed information from furnaces
- Process variables around the distillation column
- Start and end date for when a different type of LCO was feeding the column
- LCO composition

This comprised a total of about 230 variables for two years of history. AspenTech modeled this case using Aspen ProMV offline continuous to capture the time lag (i.e., process variables and feed from 1 day, 2 days and 3 days prior that affect the quench oil viscosity). Aspen ProMV can create these time lags easily. With the time lags for 1-5 days prior, the total number of variables is about 1,175.

Analysis and Results

The analysis consisted of three steps:

- Analysis without any LCO information — just feed and process variables around the column
- Analysis with LCO start and end date, without exact LCO characteristics information
- Analysis with LCO characteristics information

The results from the first analysis showed the bad actors that are process variables and feed variables. The results from the second analysis showed that there are types of LCO from specific vendors that are causing the quench oil viscosity issue. So even though specific LCO characteristics information was not available, Aspen ProMV revealed that when the company was using a specific type of LCO, the viscosity issue occurred.

For the third analysis, Aspen ProMV came up with seven principal components. Even though there were 1,175 variables, there were only seven independent directions that they could move.

The Aspen ProMV model predicted the quench oil viscosity well. Using a two-dimensional chart, with the X and Y axes as first- and second-principal components, the company was able to see the different modes of operation of the two years of data, in terms of quench oil viscosity. With contribution analysis, Aspen ProMV revealed which variables were causing high quench oil viscosity. The top contributors to the issue were LCO feed characteristics (6), feed variables (2) and process variables (7).

In addition to causal and effect analysis, the company also performed what-if analysis using the Aspen ProMV offline optimizer. Given specific LCO characteristics, they were able to calculate the worst (highest) and best (lowest) viscosity. These results will enable the company to negotiate the LCO price with the vendor, or to find an alternate vendor if the best (lowest) case is still not meeting the specifications.

Fast Implementation and Wide Impact

A key feature of this approach is that the user doesn't have to do a lot of data massaging prior to the upload. Aspen ProMV can prune the variables that are noise, taking hundreds of variables — even 1,000 variables — with acceptable time to process.

Aspen ProMV can also model the dynamic of the systems. From 1,000 input variables, it shows which variables are critical to the issue. In addition, the Aspen ProMV offline optimizer is very suited for what-if analysis to predict the outcome of quality, yield, throughput and safety, given specific values for some input variables. It provides robust solutions while still being simple to use.

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