Colombian sugar mill uses Total Organic Carbon (TOC) to prevent costly product leaks

challenge

A prominent Colombian sugar mill, Ingenio Pichichi, manufactures products derived from sugarcane for domestic and global customers. Its primary focuses are maintaining environmental responsibility, operational excellence, and profitability. Its product offering includes honey, raw sugar, white sugar, and brown sugar, processing roughly 4,300 tons of sugarcane per day. Given this capacity, it is crucial to optimize production and prevent any leaks of the valuable product into process streams. The facility's on-site lab gathers data to help make decisions that increase productivity and cost savings.

Processing sugarcane into sellable goods involves a series of steps: grinding, clarification, filtration, evaporation, crystallization, and centrifugation. Evaporation involves a multiple stage distillation system to concentrate the sugar juice. The first stage is fed with a clean steam source from a boiler. The resulting evaporation feeds the next stage and continues through all steps. The steam from the final stage is condensed using a barometric condenser and collected in a cooling tank. Condensed water from each stage is collected and added to that cooling tank to be used later as cooling water.

In order to protect equipment assets such as boilers and condensers, it is critical that the condensed water does not carry any sugar or sugar juice. This helps mitigate the risk of product and profit loss. Thus, it is important to quickly and effectively monitor for any leaks or upsets. Early detection of a product leak can help operators stop, divert, or improve a unit operation before damage or costs are incurred.

Figure 1. Sievers* InnovOx Laboratory TOC Analyzer used for Leak Detection

solution

Previously, the mill used pH, conductivity, alkalinity, brix degrees, and HPLC analysis to determine product leaks. At ambient conditions sugar is non-ionic with a neutral pH, deeming most of those methods unusable for leak detection. During production at elevated pressures and temperatures, sugar starts to decompose to damaging compounds that may cause equipment deposition, corrosion, and scaling. Additionally, when sugar decomposes it loses its HPLC signature peak. This prompts a need for a rapid, reliable, and accurate method to measure sugar.

Sugar is a carbohydrate composed of carbon, oxygen, and hydrogen. It is easily detected with the sum parameter measurement of TOC, which accurately quantifies all organic compounds in a solution. TOC analyzers work by oxidizing organic molecules to carbon dioxide (CO_2) and detecting the evolved CO_2. Ingenio Pichichi invested in a Sievers* InnovOx Laboratory TOC Analyzer (**Figure 1**) to characterize and profile the system. This enabled the

establishment of control limits for steam, condensate, and cooling water which helps optimize production and maximize profitability. TOC must be monitored at the following points:

- Feed to the first boiler
- Condensed water out of each stage
- Feed and effluent of the cooling tank

The Sievers InnovOx Lab utilizes Super Critical Water Oxidation (SCWO) and Non-Dispersive Infrared (NDIR) Detection across a wide range of carbon from 50 ppb (µg/L) to 50,000 ppm (mg/L). Expected TOC values at the mill are likely to range from 200-500 ppm, however, an upset or a leak might cause spikes from 5,000 to 20,000 ppm TOC.

conclusion

TOC analysis provides a simple and accurate analytical tool to detect leaks that could result in equipment damage and costly production losses. The prominent Colombian sugar mill, Ingenio Pichichi, needed to improve the monitoring and performance of its water streams. The evaporation stages of its milling process, which involve the repetitive heating and cooling of consecutive steam and condensate, were key points for sugar leak detection. By utilizing TOC monitoring with the Sievers InnovOx Lab at these critical steps, Ingenio Pichichi can achieve profit goals and maintain both environmental and operational objectives.