

Virtual Jar®

Case Study - Automated Coagulant Dosing for Improved Water Quality



Improving Compliance and Efficiency at Sergio Cuevas WTP with Virtual Jar

THE CHALLENGE

The Sergio Cuevas Water Treatment Plant (WTP) is the largest drinking water plant in Puerto Rico. It treats raw water from the Carraízo Lake to provide potable water to the Metropolitan Area. Sergio Cuevas treats an average of 90 million Gallons per Day (MGD). Under normal conditions the plant addresses high Total Organic Carbon (TOC) and manganese levels. Due to the size of Carraízo Lake, there has been an ongoing accumulation of solids containing elevated levels of microorganisms, TOC, manganese, hydrogen sulfide (H₂S), and algae. Over the past few years, the plant has faced elevated Disinfection by-products (DBPs) due to poor raw water conditions. High chlorine levels must be applied in addition to other treatment chemicals like coagulants, flocculants, lime, and sodium permanganate, increasing the chemical costs. The elevated DBPs created a situation in which they struggled to stay in compliance. The initial strategy to address the DBP issue was to determine a higher dose of the GC 8783 coagulant. During this time, operators

adjusted the injection rate based on the morning jar test results and the current average raw water flow. Further adjustments occurred when the plant was notified of a flow change or when the plant laboratory recommended a new dose.

IMPACT ON THE PLANT

The initial strategy to increase chemical feed to address DBP compliance issues resulted in increased chemical costs by approximately 25%. The lack of online coagulant flow rate measurement, continuous raw water flow rate measurement, and the absence of a constant dosing control system resulted in the frequent loss of process control and non-compliance conditions. There was also a challenging situation in which the plant operators and management had difficulty making the necessary coagulant injection rate adjustments. The problem was made difficult due to the manual aspect of the plant's operational controls, which introduced a higher risk of error and increased the chances of compliance violations.

THE SOLUTION

Usalco evaluated the issue and proposed our digital dosing module to solve the challenges. The control system includes a Streaming Current Monitoring unit (SCM), a UVA254 online analyzer, and new injection flow meters. Additionally, the solution required a raw water flow measurement indicator to process the data acquired remotely from a monitor at Carraízo Lake. A Programmable Logic Controller (PLC) was employed as the main control logic sequence to implement the developed control modes and strategies.

THE CONTROL SYSTEM INCLUDES THREE DIFFERENT MODES:

SCM/UVA AUTOMATIC CONTROL MODE: In this mode, the system automatically adjusts the coagulant injection rate and dose based on the coagulant required driven by the raw water conditions, the treated water conditions, and a desired SCM set point value which assures proper coagulation and plant compliance. The system continuously monitors results using the online UVA254 analyzer, which constantly analyzes the raw and treated water UVA levels; the control system uses those levels to calculate the percentage of TOC removal continuously and compares the results against the required removal levels. If, after four hours (plant retention time), the TOC removal average stays within the pre-established removal range, the system maintains the SCM set point. However, if this average is outside the boundaries of the pre-established removal range, the control system decides to either increase or decrease the SCM set point. This is a unique Usalco autocorrection strategy for the SCM control-based systems.

AUTOMATIC DOSE (PPM) CONTROL MODE: The system automatically adjusts the coagulant injection rate to maintain



the desired coagulant dose considering the raw water flow rate variations. The desired dose or ppm set point is determined by plant laboratory jar test results based on the raw water conditions or pre-established dosing curves (if jar test results are unavailable).

MANUAL CONTROL: In this mode of operation, the plant operators can decide and set the percentage of the injection pump capacity and injection rate they want to operate at. The system's coagulant flow meters will continuously measure and display the flow rates for the operators. This mode of operation is used in certain circumstances, such as for equipment maintenance.

THE RESULTS

After the implementation of Virtual Jar, Sergio Cuevas enjoyed the following benefits:

- 01 Plant personnel benefited from an easier, more precise, and stable operation in setting and maintaining the desired coagulant dose.
- 02 Proper coagulant dosing control has substantially reduced the chances of process upsets and compliance violations
- 03 The average operating dose and associated operational costs have been reduced by 25% while maintaining the required percentage of TOC removal necessary to achieve the required DBP compliance limits.

