

GUAYNABO WTP IN PUERTO RICO SAVES THOUSANDS WITH UV254 MONITORING PACKAGE

SUMMARY

Dealing with fluctuating water sources is not an easy task for plant operators. Seasonal variation, heavy rain fall or accidental contamination events change the raw water quality, requiring immediate attention. This is a familiar scenario for Facility Manager, Nancy Ma. Cáceres Acosta at the Los Filtros Water Treatment Plant in Puerto Rico. She has been producing high-quality water for 256,000 local residents, receiving surface water from the Guaynabo and Bayamon River. In an initiative to improve plant performance, Sra. Cáceres Acosta coordinated with Daniel Smith of

Montanas Electric, Inc. and Orlando Laguer of Nator Corporation to integrate a coagulation optimization package at the facility. Key aspects of the package included a UV254 organics analyzer, dosing control panel, and remote telemetry system. Initial Phase 1 testing presented far greater results than expected with an average monthly reduction of 22,917 lbs of chemical coagulant equaling \$9,831 in saving. In addition to the initial cost saving on chemicals, the plant is confident their formation potential for DBPs is limited, increasing water security.

LOS FILTROS GUAYNABO WATER TREATMENT PLANT



The Los Filtros Guaynabo Water Treatment Plant (WTP) in Guaynabo is located on the northern coastal valley of Puerto Rico. The plant has the capacity to produce 30 millions of gallons per day (MGD) of drinking water serving approximately 256,000 local residents. Source water for the plant is drawn from the Bayamón river basin, springing from the mountains into the Bayamón River and main tributary, Guaynabo River (Monroe 1980). The two rivers have historically been impacted by both naturally occurring and man-made organic matter.



The murky waters are saturated with natural organic matter (NOM) comprised of humic substances as well as anthropogenic organic pollutants from the surrounding land practices (Cáceres Acosta 2013). Heavy rainfall events around the island are accompanied by soil erosion, causing the rivers in the basin to “run red”. High organic concentration, color and turbidity (NTU) associated with the rainfall events have always posed operational challenges for the receiving plant.

A CLOSER LOOK AT CONVENTIONAL WATER TREATMENT

The Guaynabo WTP is a conventional filtration drinking water facility. The raw water delivered from the intake facilities enters a rapid mixing chamber where chemical coagulant is added. The pre-treated water moves to the flocculation basin, then proceeds to one of the five sedimentation tanks where floc settles from the water. Settled water moves through eighteen sand filters to further remove any dissolved matter. Filtered water is then dosed with chlorine for disinfection before moving to the distribution tank (EPA 2009). The facility is required to meet regulations associated with the Safe Drinking Water Act, including compliance with the Environmental

Protection Agency (EPA) Stage 2 Disinfectant/Disinfection By-Product (D/DBP) Rule. The D/DBP rule protects consumers from harmful disinfection byproducts (DBPs) such as Trihalomethanes (THMs) and Haloacetic Acids (HAA5). Historically, the facility has had an excellent record remaining in compliance despite the challenging source water. In an initiative to improve plant performance and gain a better understanding of the raw water NOM, Facility Manager Nancy Ma. Cáceres Acosta was interested in investigating new technologies for detecting organics that would assist in plant optimization.

AN EFFICIENT AND ECONOMICAL APPROACH TO PLANT OPTIMIZATION

TABLE 1: RAW WATER QUALITY RANGES FOR PARAMETERS MONITORED AT THE LOS FILTROS GUAYNABO WTP.

PARAMETER	TYPICAL RANGE
Turbidity, ntu	5-4,000
Dissolved Oxygen, mg/L	4-8
pH	6.5-8.5
ALKALINITY, MG/L AS CaCO_3	90-189
Temperature, °C	24-29
Total organic carbon, mg/L	1.6-6.0
UV254, cm^{-1}	0.070-0.835

Optimizing plant operations, minimizing operating costs, and remaining in compliance were the goals Sra. Cáceres Acosta articulated in her first meeting with local Instrumentation Specialist, Daniel Smith of Montanas Electric, Inc. and System Controls Engineer, Orlando Laguer of Nator Corporation. Assessing historical water quality trends, Mr. Smith and Mr. Laguer designed a complete monitoring and dosing system that would address the issue of organics detection with UV254 (ultraviolet absorbance at 254 nm) as an indicator of NOM.



UV254 has a biased towards reactive aromatic organics that tend to be most problematic for operations. These organics will readily consume coagulant and combine with chlorine to form DBPs. Therefore, monitoring aromatic organics with UV254 was deemed an important parameter for calculating optimal dose. Instant notification (10-15 seconds) of organic contamination events was also valuable to monitor fluctuations in raw water that had historically posed operational challenges. The UV254 M3000 model from Real

Tech Inc. was installed with dual feed capabilities to monitor both raw and post filter streams as an indicator of process efficiency and to establish TOC equivalent values. A 5 micron pre-filter was installed to filter out sedimentation and large particulate matter that would occur during occasional periods of high turbidity (>4000 NTU), typical during the spring and fall seasons. The package was controlled by a local plc HMI Dosing Control Panel with all historical water quality data. This information was used in conjunction with real-time water chemistry, as presented in Table 1, to aid in the development and future control of an optimal dosing program.

A custom algorithm was formulated for the program to automatically adjust chemical dosing, allowing for significant reductions in chemical coagulant while meeting the required TOC removal percentages for compliance. The control panel also served as a pass-through for the remote telemetry system that communicated information to a web-based customized GUI page with alarm and event notification for management and operational personnel. A site specific testing and dosing adjustment protocol was followed to ensure water safety and compliance to regulations during Phase 1 testing.

SMALL CHANGES, BIG RESULTS

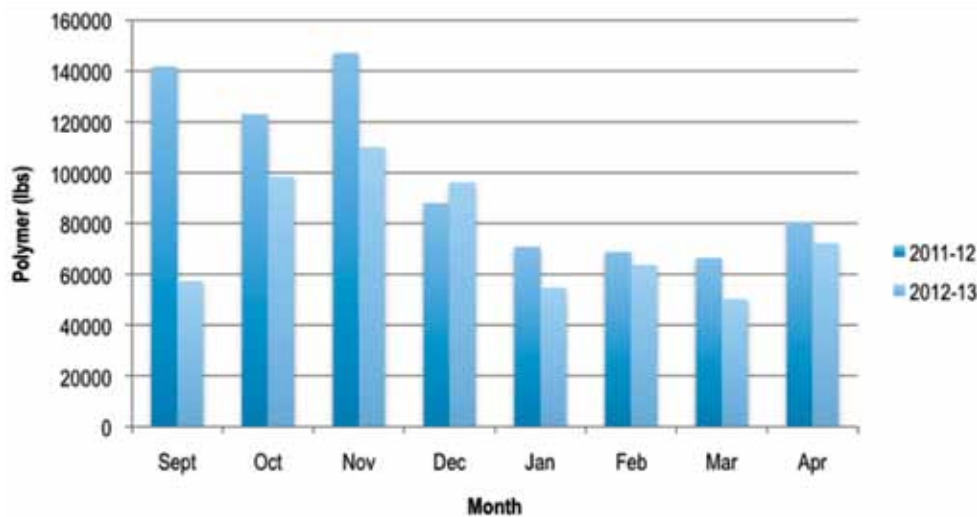


FIGURE 1: MONTHLY POLYMER CONSUMPTION (IN POUNDS, LBS)
COMPARISON OF SEPTEMBER 2011-APRIL 2012 TO SEPT 2012-APRIL 2013.

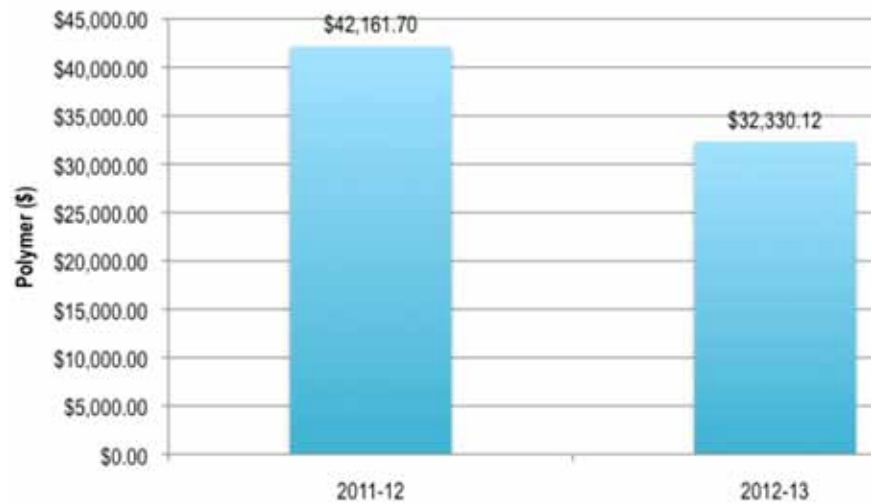


FIGURE 2: AVERAGE MONTHLY COST (IN DOLLARS, \$) OF POLYMER FOR
SEPTEMBER 2011-APRIL 2012

Phase 1 testing results from the UV254 monitoring and dosing control package were greater than expected. Data collected from an eight month period of continuous operation was compared against the corresponding months from the previous calendar year. Comparison of monthly polymer consumption in pounds is displayed in Figure 1. On average the plant experienced a 22,917 lbs reduction in chemical coagulant usage per month. This equated to a decrease of 23%, allowing the facility to save \$9,831 USD on average per month as shown in Figure 2. As a result of optimizing the chemical coagulant dosage, the facility also realized a reduction in filter bed backwash cycles of 23%. A decrease in backwash frequency meant more water in the system for production.

Additionally, a significant 23% reduction was seen in sludge formation which in turn decreased removal costs. Beyond the cost savings and optimization, the facility remains in compliance, meeting the required TOC removal and improving DBP control.

“ Through this system, plant operators and supervisors can evaluate results for the operation with higher accuracy and ease.”

-NANCY MA. CACERES ACOSTA, BS, MSEP
GERENTE SISTEMA GUAYNABO

FUTURE WORKS

With the success of the Phase 1 testing, Mr. Smith and Mr. Lauger intend to continue studies at the Guaynabo facility to gain a better understanding of the water chemistry. This will allow them to enhance the package through adjustments in chemical selection for optimal removal. The dosing package will also offer an option for multiple wavelength UV analysis from Real Tech to compensate for the effects of turbidity and provide additional security through organics analysis. Reducing chemical consumption and limiting DBP formation, while increasing water safety during contamination events will be the key driving factors as the study continues.

ACKNOWLEDGEMENT

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