CASE STUDY

COMPARING THE NEW HACH 5500SC AMMONIA MONOCHLORAMINE ANALYZER TO THE COMPETITION

Innovations in the 5500Ssc Ammonia Monochloramine Analyzer's user interface and implementation of pressurized reagent delivery system pushed it past the competition at a major water treatment plant

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A new Hach 5500sc Ammonia Monochloramine Analyzer for drinking water chloramination was tested at Bachman WTP in Dallas, TX against both lab and process analyzers from other manufacturers and was considered the winner. The new user interface allowed for easy startup and operation and the new pressurized reagent delivery system performed reliably. Combining the proven direct colorimetric method of analysis with a new dual-colorimeter design, the analyzer delivered more frequent, highly accurate measurements. These innovations facilitated better chloramination process control.

Introduction

Consistent and reliable disinfection is one of the most important goals for drinking water treatment. There are many challenges associated with disinfection, and many factors must be taken into account in order to choose the right disinfection process and keep it under control. Many regions and municipalities in the United States employ chloramination for post-chlorination to mitigate concerns related to disinfection byproduct (DBP) formation and extend the disinfectant useful life throughout the distribution system. A new online analyzer for monitoring and control of chloramination was tested at Bachman WTP, one of the three drinking water treatment facilities in Dallas, Texas. Chloramination is utilized at all Dallas water treatment plants for three main reasons: to ensure an adequate disinfectant residual is maintained throughout the city; to reduce disinfection byproducts formation, and to address taste and odor issues.

Business Profile

Bachman Water Treatment Plant, built in 1930, now has a 150 MGD capacity and averages 100 MGD in a normal year. The plant employs a combination of lime softening and conventional treatment. The effluent is chloraminated prior to entering the distribution system. Chloramination control tests used by the facility include online and laboratory monitoring of monochloramine, total ammonia, free ammonia, and total chlorine.

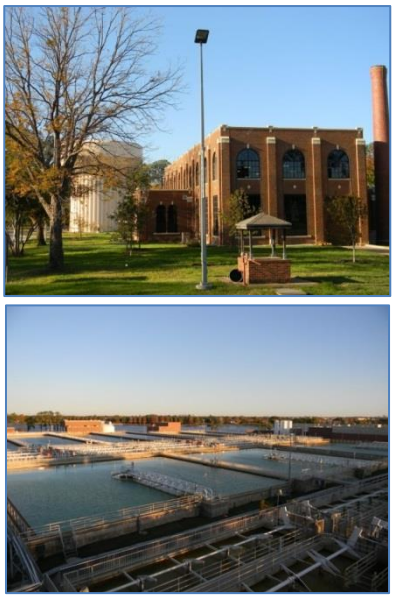

Figure 1: Bachman WTP test facility in Dallas, TX

The plant personnel are always seeking better ways to control their process and have always tried to implement best practices. The biggest challenge is the equipment upkeep. The talented technical staff at Bachman is quite busy, so plant management is looking for ways to employ the most reliable analytical instrumentation.

Business Situation

A new Hach 5500sc Ammonia Monochloramine Analyzer (AMC) was installed in the summer of 2014 next to the existing online instrumentation just prior to discharge into the distribution system. The parameters

measured at the same sampling point were total chlorine, monochloramine, total ammonia, and free ammonia. The study compared results received from several analyzers utilizing different technologies, as well as with results of laboratory analyses for total chlorine, total ammonia, and free ammonia. The other process analyzers in this study included a Hach CL17 Total Chlorine Analyzer, a Hach APA6000 Ammonia/Monochloramine Analyzer, and a "Brand X" Ammonia Analyzer.

Figure 2A: Hach process instrumentation measuring finished water prior to entering the distribution system

Figure 2B: Hach 5500sc Ammonia/Monochloramine Analyzer

The laboratory methods and instrumentation used for verification included a Hach Amperometric Titrator Model 19300 (total chlorine), a Hach DR 2800 Spectrophotometer (total ammonia, Method TNT830), and a Thermo-Orion GSE Ammonia probe (total and free ammonia), further referred to as a Thermo GSE probe.

Results and Discussion

First impression of the plant personnel recorded during the startup was "how easy it is to install the analyzer." The interface was concluded to be "very user friendly" and "easy to use, with clear step-by-step instructions." General feedback: the analyzer was easy to operate and maintain. These conclusions were dictated in part by performance of the pump-less reagent delivery system using pressurized air. The technicians found the new analyzer menus and diagnostics contributed to the ease of maintenance: "[The] dashboard is aesthetically pleasing [and the] menus give detailed instructions." The operators also observed, "… great accuracy against our laboratory meter (gas sensing probe). [We are] very satisfied with the data the 5500sc AMC is producing."

The study results were sorted to compare: monochloramine and total chlorine (Figure 3), total ammonia (Figure 4), and free ammonia (Figure 5) analyses.

Measuring the concentration of the target disinfectant is important to implement both better process control (monochloramine) and regulatory reporting (total chlorine). It is important to see a good agreement among the measurement platforms, both on-line and laboratory. Correlation rate between the 5500sc AMC and either CL17 or lab total chlorine analysis results were better than 98%!

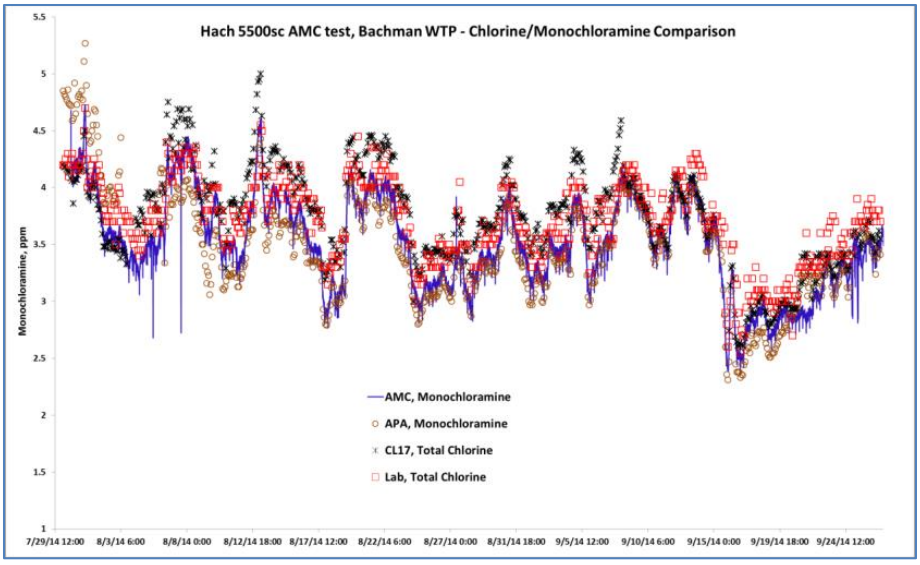

Figure 3: Comparison of total chlorine and monochloramine

The new 5500sc AMC analyzer uses two colorimeters to conduct direct measurement of monochloramine and total ammonia simultaneously every 4.5 minutes—almost twice as often as the APA6000. More frequent analysis was achieved without increasing reagent use – again contributing to reliability and lower maintenance costs. A greater measurement frequency provides better data for improved process control. From an accuracy standpoint, the direct colorimetric method used by Hach Ammonia Monochloramine analyzers showed to be better than continuous methods based on amperometric, potentiometric, and/or ISE technologies[1].

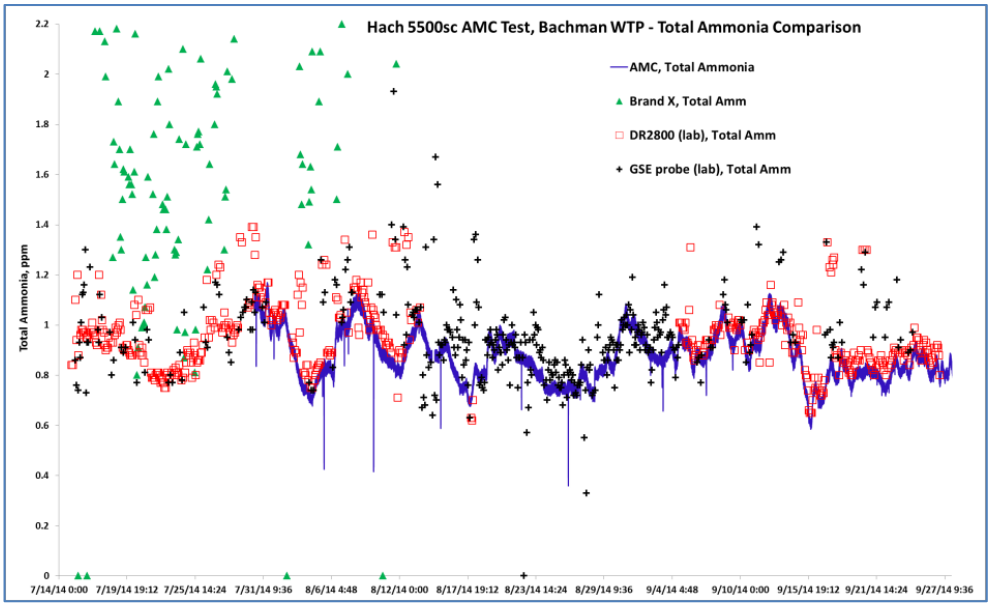

Figure 4: Total ammonia analysis results obtained by three online and two lab instruments

As seen in Figure 4, total ammonia results generated by the new Hach 5500sc AMC analyzer agreed well (89%) with the laboratory analyses using an EPA compliant colorimetric method (Hach Method 10205, ULR). The other lab instrument built on the GSE technology showed poor agreement with both 5500sc AMC and the colorimetric lab method (about 60%) for total ammonia determination. This may be explained by the fact that electrochemical sensors in general rely heavily on calibration and are influenced by other factors such as pH and temperature (the latter is especially pronounced for ammonia ISE probes). Such probes may not be very accurate at low concentrations of the analyte without additional calibrations.

The last, but perhaps most important parameter for control of chloramination is the concentration of free ammonia. Ideally, a treatment system should attempt to maintain free ammonia in a range up to 0.1 mg/l while ensuring the free ammonia never reaches zero. This tight control is nearly impossible using only grab sample measurement. A reliable on-line system such as the Hach 5500sc AMC is required, which calculates free ammonia from two direct measurements (total ammonia and monochloramine) conducted in parallel using the new dual-colorimeter design.

The only comparison of free ammonia measurement that could be conducted was between the new 5500sc AMC analyzer and the Thermo GSE probe. Such comparison proved to be difficult, because no published accuracy specifications were found for the GSE probe.

The graph in Figure 5 shows that the GSE probe generally tracked the Hach 5500sc AMC and the APA6000 results; this cannot be said of the potentiometric ammonia sensor (Brand X).

[1] Electrochemical sensors are built on the principle of consumption of the electrodes and therefore require regular calibrations to provide accurate measurements.

The free ammonia correlation rate between the 5500sc AMC analyzer and the GSE probe readings was calculated to be ~40%, based on the criteria dictated by the 5500sc AMC accuracy specification of ± 5% or 0.01 ppm (whichever is greater).

Given that the accuracy of ISE probes is strongly dependent on calibration and is influenced by multiple interferences, it is safe to conclude that there was a general agreement between the compared technologies.

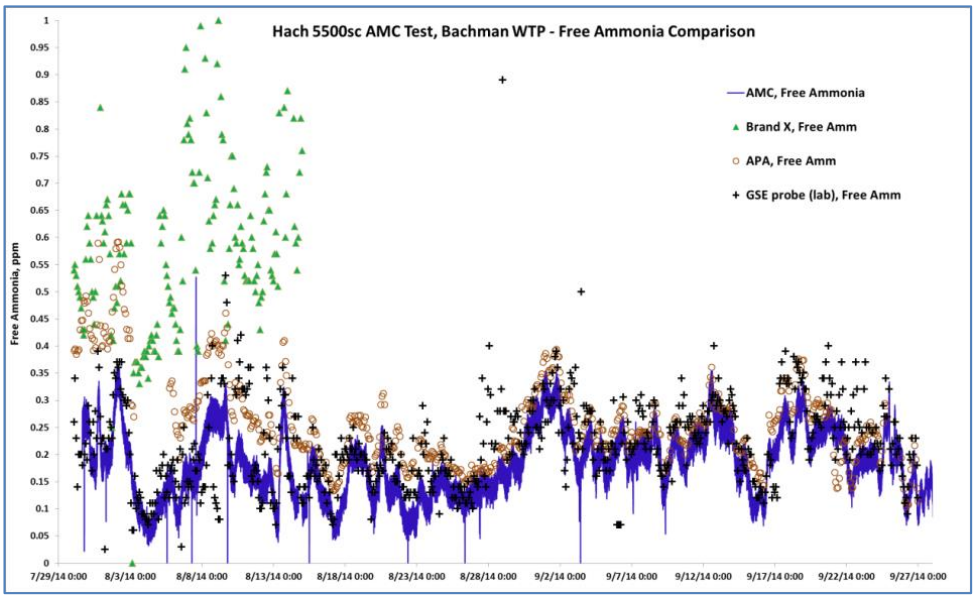

Figure 5: Comparison of free ammonia analysis results for process and lab analyzers

Chaise Holmgren, plant manager, best summed up the overall customer experience during the test of the 5500sc AMC when he said, "We love this product."

Conclusions

Analytical accuracy of the new Hach 5500sc Ammonia Monochloramine Analyzer fully met Bachman plant expectations.

The increased frequency of Hach 5500sc AMC measurements allows plants to react faster to changes in water quality and further optimize their chloramination processes.

The new design and user interface with active help menus minimize maintenance requirements and make regular interactions with the analyzer easier and more intuitive.

Given the pump-less reagent delivery system, advanced communication and self-diagnostics features (e.g. PROGNOSYS$^{(TM)2}$) of the Hach 5500sc AMC analyzer, it is an accurate, reliable tool for monitoring and controlling the chloramination processes in drinking water treatment.

Acknowledgement

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[2] PROGNOSYS is a predictive diagnostic system that proactively alerts users to the maintenance needs of their instrument. This allows the user to confidently determine whether changes in their measurements are due to changes in their instrument or their water.