Case Study
Trihalomethane Removal Systems
Rockville, MD

The Problem

The City of Rockville, Maryland, (just outside of Washington, DC) has taken a proactive approach to meet water quality regulatory compliance for their drinking water system. However, an unexpected notice of violation for exceeding the Maximum Contaminant Level (MCL) of Total Trihalomethanes (TTHMs) in 2008 caused the City to critically examine water quality in their water distribution system. TTHMs are chemicals that form when chlorine reacts with naturally occurring organic matter found in drinking water, such as Rockville's drinking water source, the Potomac River. After performing an initial distribution system evaluation (IDSE) for the Stage 2 Disinfectant and Disinfection Byproduct Rule, the City realized that elevated Total Trihalomethane (TTHM) levels may be hard to deal with in the future.

Rockville's managers created an internal water quality team that met once a month to analyze water quality data and explore ways to lower TTHM levels in the distribution system. Engineers from the firm Hazen and Sawyer also provided valuable help with the analysis. The analysis of Rockville's water distribution system revealed a significant weakness that was contributing to high TTHM levels: the 8 MG Hunting Hill tank (Figure 1).

Figure 1. The 8 MG Hunting Hill tank has a high water volume and low turnover, which results in high water age and elevated THM levels

The Hunting Hill storage tank was constructed in 1969 as an oversized steel reservoir located at ground level. The tank is approximately 96-feet in height and 135-feet in diameter and requires a high water level to provide sufficient water pressure. With a low average daily turnover of only 0.65 MGD, or about 8%, average detention time in this tank can exceed 10 days and result in high water age. THMs continue to form with time, so high water age creates higher levels of THMs (TTHM levels above 140 ppb have been measured at this tank). The City of Rockville considered a range of options for reducing water age, including tearing down the tank and building an elevated tank with less capacity and better turnover in its place.

The Solution

Rockville Water Treatment Plant Staff identified in-tank aeration as one possible tool for lowering THM levels in the distribution system. Using information from industry publications and literature, several members of the operations staff worked together to fabricate and install a spray aeration system to test the concept in the 3 MG Carr Avenue standpipe. Their home-built design was a great success, resulting in a 50% reduction of TTHMs in the Carr Avenue tank.

With validation of the in-tank spray aeration concept in hand, the City of Rockville considered their options for installing a much larger system in the Hunting Hill tank. Because of the imminent arrival of the Stage 2 Rule, the City felt urgency to get a solution designed, installed and operating as soon as possible. And, because the design of an in-tank aeration system sized for this tank required significant process engineering and structural design, the City opted for a design-build project. "Public Works wanted to have the project finished and validated before the October 2013 start of Stage 2 sampling," explained Rockville Civil Engineer John Hollida. Rockville's RFP for the project was released in late 2011. "Guaranteeing results was paramount for this project," explains Hollida. "The RFP requested proposers to guarantee a minimum THM removal percentage. Furthermore, the City structured the contract to require a minimum of 30% THM removal, with a significant financial penalty if the aeration system failed to meet the performance goals."

SUEZ Advanced Solutions and PAX Water Technologies proposed their Trihalomethane Removal System (TRS) to meet the requirements of the project. TRS is a custom design-build, in-tank aeration system that utilizes mixing and aeration together to maximize THM removal. Unlike more traditional approaches that require utilities or engineers to source aeration hardware and develop their own scaling relationships and installation design, TRS utilizes a proprietary design process (the NEPTUNE Toolbox) that ensures that each aeration system is optimized for energy efficiency and installed in a manner that ensures reliable performance for the life of the tank.

SUEZ Advanced Solutions and their subcontractor, PAX Water, were awarded the contract and work began in the summer of 2012 (Figure 2a,b). Construction and installation of the system was complicated by the large size of the tank, the numerous spray nozzles installed, and the inevitable complexities and delays that occur with any large infrastructure upgrade. By July 2013, the system was up and running and validation testing had begun.

The Solution

Figure 2a, b. Components of the TRS include a network of header pipes and spray nozzles installed on the roof of the tank and the PAX Water Mixer installed on the floor of the tank.

Validating the performance of any in-tank aeration system is complex due to the large number of THM measurements required and the difficulty in isolating the effects of the aeration system from other factors that affect THM levels.

To assist the validation process, and provide a large number of THM measurements in a short period of time, the PAX Water team provided a Parker Hannifin THM analyzer to the City of Rockville. The Parker Hannifin analyzer is a purge/trap system that utilizes an advanced detector system to provide species-specific THM measurements at the ppb level of accuracy in 30 minutes and can perform many analyses per day. This provides operators with a tool not only to validate the performance of an aeration system, but also to study THM formation throughout their treatment plant and distribution system. And because the Parker Hannifin analyzer is not approved by the EPA for compliance purposes, there is no obligation for utilities to report those results. “It would be difficult to track THM levels in the City’s water distribution system and make changes to treatment or operations without this analyzer providing near real-time THM information. Without the analyzer, we’d have to depend on certified laboratory THM results with a two-plus-week turnaround time,” noted Hollida.

The Conclusion

The final validation measurements were taken in September 2013. The City of Rockville performed split THM measurements using both the Parker Hannifin analyzer and a contract laboratory (that used an EPA-approved method). The results showed that the TRS removed an average of 53% of the THMs in the tank (Figure 3). The results from the Parker Hannifin analyzer closely tracked those from the contract lab, but were slightly lower in absolute value. The TRS has remained in operation ever since.

"When Public Works started exploring water quality solutions for the Hunting Hill tank, there were not many tools at the City's disposal," explains Hollida. "The tank itself is enormous and one option was to take the tank down and replace it with an elevated tank. That would have cost the City between $2M and $2.5M per million gallon of storage. Installing an aeration and mixing system ended up being the only viable option for saving this tank."

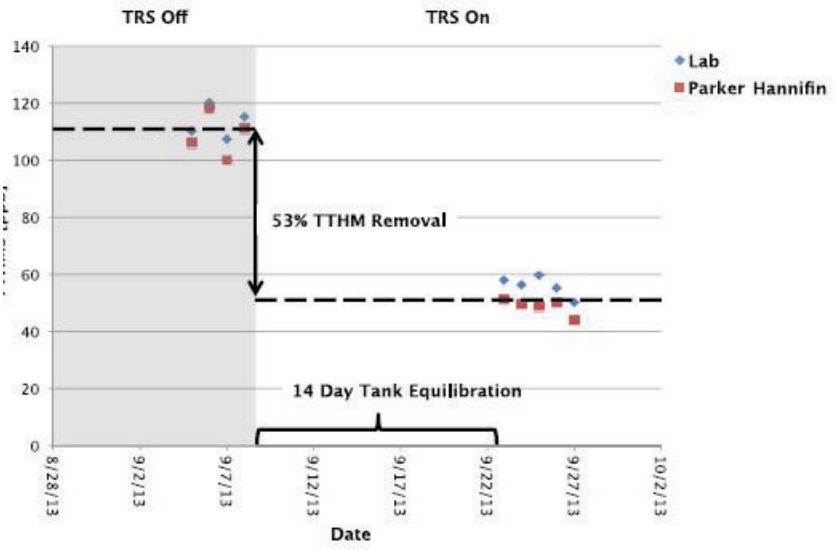

Figure 3. TTHM levels in water leaving the Hunting Hill tank with the TRS off (shaded in gray) compared with THM levels with the TRS on. After the TRS is turned on, time is required for the TTHM levels to reach a steady-state level of reduction – in this case 14 days.

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> —John Hollida, Civil Engineer, Rockville, Maryland