A Proactive Approach

Empty More Avenue reservoir during installation of in-tank aeration system

Filled More Avenue reservoir with in-tank aeration system in operation

By Peter S. Fiske

California utility tackles THM control

San Jose Water Co., located in the heart of Silicon Valley in California, is used to being on the forefront of innovation. As one of the largest and most technologically sophisticated investor-owned utilities in the U.S., it has taken a proactive approach to improving drinking water quality and lowering operating costs.

Over the past two decades, San Jose Water, like other water utilities in the western U.S., has faced unprecedented challenges due to drought, including reduced water supply and lower quality of water sources. At the same time, water quality regulations have become more stringent, forcing the utility to meet higher standards for finished water quality while utilizing increasingly challenging raw water supplies.

San Jose Water carried out a thorough and sophisticated water quality monitoring program to protect public health. In February 2014, these programs alerted management to a significant new threat to drinking water quality: disinfection byproducts (DBPs).

"As part of our Stage 2 DBP monitoring program, we evaluate DBP levels across the system," said Adam Feffer, water quality engineer for San Jose Water. "In February 2014, results showed a significant increase in DBP levels. Our wholesale supplier (Santa Clara Valley Water District) corroborated that water quality was deteriorating due to drought. The projection was that it was going to get worse."

Drought & DBPs

Drought has a direct effect on DBPs in two ways. First, lower-than-average water flows often result in higher concentrations of organic matter in raw water: Organic matter reacts with chlorine to form DBPs. Second, due to the geology of the area, bromide levels in raw water also increase. Bromide drives the formation of bromoform and other bromine-containing DBPs.

Santa Clara Valley Water District had several treatment options to drive down organic levels in its water. One option was to increase the application of powdered activated carbon (PAC). PAC was used by Santa Clara historically only for taste and odor issues—not for lowering DBPs. But in February 2014, it was not clear if Santa Clara would be able to use this approach to improve the water prior to its arrival in the San Jose Water system, or how much of effect it would have.

"PAC is not an economical solution to address total organic carbon," Feffer said. "If it's all you have onhand, it's something, but it's very expensive."

In-Tank Aeration Approach

The part of the San Jose Water system that caused the greatest concern was the western portion. Water for this part of the system is treated by Santa Clara Valley Water's Rinconada Treatment Plant. It then enters the San Jose system at the 12-million-gal More Avenue reservoir. Five DBP sample locations downstream of the More Avenue reservoir showed significant elevations in trihalomethane (THM) levels. While the water system remained in compliance, managers at San Jose Water wanted to eliminate the risk of a future operational exceedance in the summer of 2014—when THM levels were expected to be highest. With no guarantee that Santa Clara's application of PAC would be sufficient to eliminate the problem, San Jose Water had to act on its own, and act fast.

"I had recently attended a webinar on the subject of in-tank aeration as a means of reducing THM levels in finished drinking water and it seemed like a promising approach to try," Feffer said. "In-tank aeration utilizes conventional water aeration technology in a new way. Instead of transferring oxygen into water, aeration is used to strip THMs out of the water after they form. The advantage of this approach is that aeration can be applied in selective parts of a water distribution system—lowering THM levels where the need is greatest."

PAX Water Technologies began the design phase of the project immediately. The aeration system would consist of seven novel surface aerators, modified to improve their efficiency at removing THMs. The system also would use two mixers to efficiently deliver water into the process zone created by each aerator to maximize removal of THMs. Finally, the system utilized a custom-designed air-handling unit (AHU) to exhaust THMs out of the headspace.

"We did not get the green light to begin construction until April," said Rich Ducote, project lead with Utility Service Group, a partner of PAX Water Technologies. "We faced a number of challenges, including the placement of the AHU and the fact that residents lived right on the other side of the fence. Our system had to be energy-efficient, easy to maintain and quiet."

During the installation phase of the project, water quality managers at San Jose realized that an additional resource that could help them manage THMs was right next door. Aqua Metrology, in neighboring Sunnyvale, Calif., had developed an online THM analyzer that could rapidly and reliably measure THM levels at the More Avenue reservoir. The system uses a colorimetric method based on Fujiwara reactions and a fully automated sample collection and analysis system to provide THM data every four hours. The system was added to the project and housed in a custom enclosure next to the tank.

The aeration system installation was completed in mid-August. During its first phase of operation, THM reduction was significant.

"We are seeing THM levels that are 40% to 70% lower [when the water leaves] More Avenue than [when it comes] in," Feffer said. Total removal rates may be higher because some THMs also form in the water while it is in the More Avenue reservoir.

While San Jose Water was fully prepared to face a major increase in THM levels in the summer, it had lots of help. Santa Clara Valley Water aggressively pursued the use of PAC to lower TOC, and it also made some changes to system operations to reduce residence time in the treatment process—all in an effort to reduce DBPs and give its retailers more time to address DBPs in their systems.

"We are very happy so far," Feffer said. "We are seeing excellent results from the system, and noise has not been a problem. It's impressive how fast this project went." w&wd

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Figure 1. THM levels before and after in-tank aeration