http://dx.doi.org/10.5991/OPF.2017.43.00XX

Cliff Tormaschy is president of Medora Corp. (www.medoraco.com), Dickinson, N.D.

Get Custom THM Stripping Without Breaking the Bank

To limit costs, consider site-specific parameters if installing off-the-shelf trihalomethane removal systems. **BY CLIFF TORMASCHY**

DISINFECTION by-product (DBP) regulatory compliance requires public water systems to achieve total trihalomethane (TTHM) levels of 80 µg/L (ppb) or less for a locational running annual average throughout a community. Often a water treatment plant's most cost-effective approach is to continue using the same treatment processes used in the past but strip excess THMs from the treated water by using a spray aeration system. Such a system may be custom designed or formed from off-the-shelf equipment.

SYSTEM CONSIDERATIONS

In comparison, off-the-shelf THM removal spray aeration equipment may offer advantages over a custom-designed system, such as lower cost, faster delivery, and the flexibility to move the entire system to a different tank if city flow patterns change. However, to realize such advantages, important issues (e.g., site and hydraulic concerns) must be considered before applying off-the-shelf equipment to a water system for THM removal.

Clearwell vs. Distribution System. Stripping THMs at a clearwell rather than in the distribution system is a decision that presents the advantage of the whole plant's output being treated, assuring THM compliance throughout the city. Sufficient electric power is usually nearby, too.

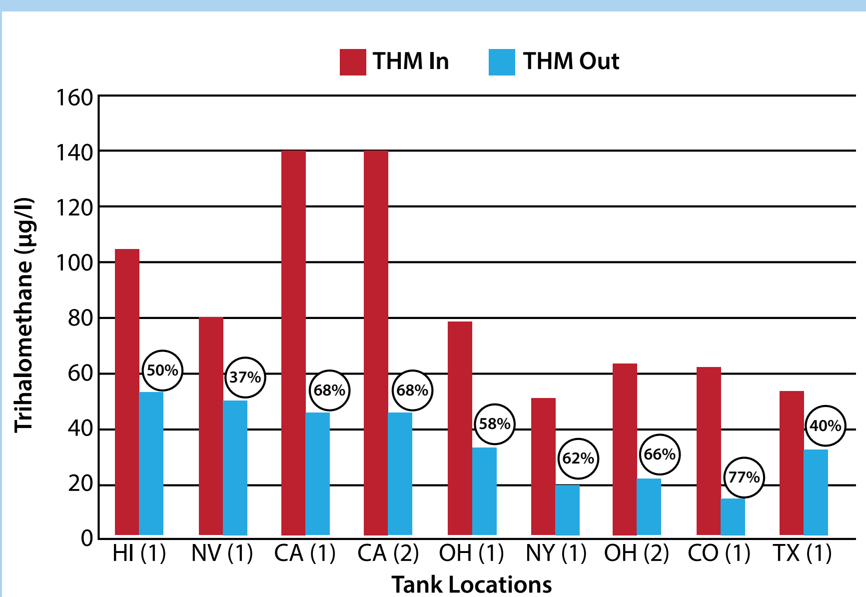
A disadvantage to a clearwell site is that the city may have to purchase a larger system. For example, a water treatment plant may produce 7 mgd, but only a part of the city using 0.5 mgd has a THM-compliance problem. Instead of purchasing a clearwell system, it may make more sense for the city to install an in-line THM removal skid to treat just the neighborhood using 0.5 mgd.

Another disadvantage of locating THM stripping equipment in a clearwell is that THMs are usually low there, so THM removal decreases. For example, only 40 µg/L may be in the water at the clearwell, but sufficient formation potential in the water could drive THMs up to 150 µg/L at the end of the distribution line.

A solution is to establish intense mixing at the front of the clearwell to help convert the formation potential into actual THMs, and then strip the higher THMs out at the back of the clearwell. In the

THM Removal Results

Spray aeration systems can be designed for virtually all reservoirs and any THM reduction result. The data below are from systems designed for 40–50 percent THM removal and show removal rates based on actual THMs entering and leaving the reservoirs.



PHOTOGRAPHS: MEDORA

Stripping THMs at a clearwell rather than in the distribution system allows a utility to treat an entire plant's output, assuring THM compliance throughout the city.

aforementioned example, after mixing at the front and stripping at the back of the clearwell, the THMs may leave the clearwell at 35 µg/L but only rise to 50 µg/L at the end of the line, which is well under the compliance limit. A cursory look at the THM reduction at the clearwell in this example would indicate the stripping system removed only 5 µg/L of THMs, reducing the level from 40 µg/L to 35 mg/L. However, a comparison at the end of the line tells the whole story—a reduction of 100 µg/L was achieved, putting the system well under the compliance limit.

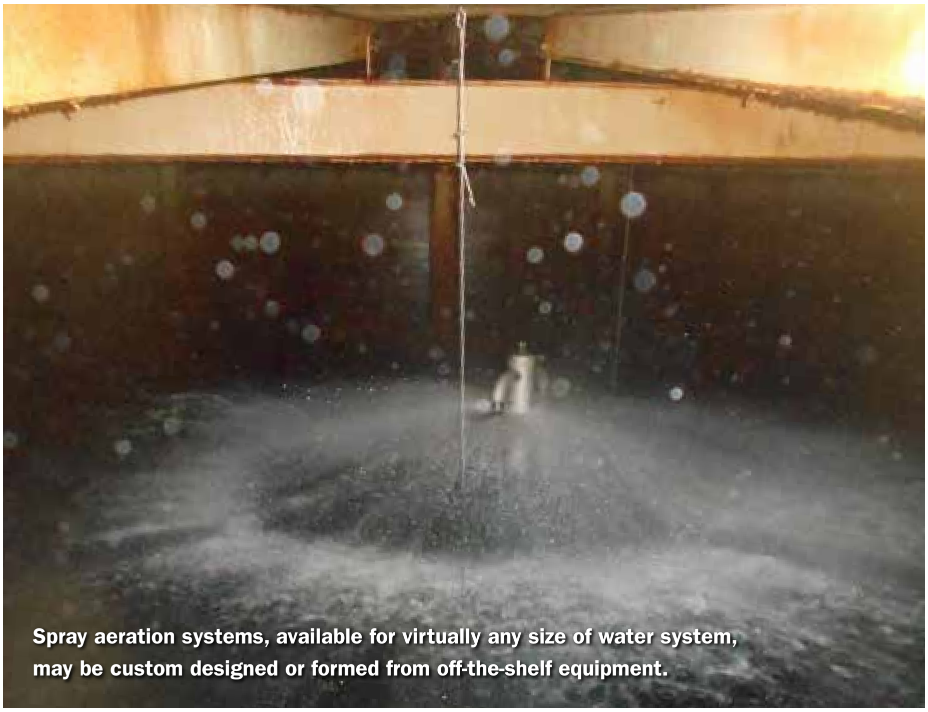
Another disadvantage of siting a removal system at the clearwell is that there may not be enough headspace for a spray aeration THM stripping system. However, making a small hole in the clearwell's roof and putting the spray aeration equipment into a small "dog house" at the top can overcome the problem. Then the water can be pulled up from the clearwell, treated, and drained back into the clearwell.

Distribution Tanks. Most distribution tanks use just one pipe to fill and empty the tank, and that pipe has a "tee" in the mainline. Sometimes a city will assume, based on supervisory control and data acquisition (SCADA) system averages, that a THM stripping system in a tank can help achieve compliance in a nearby section of the city. But often it turns out that, in the peak THM season, too much water flows down the mainline and past the tank tee—not into the tank where it can be treated. SCADA averages can be misleading for placing a THM stripping system into a one-pipe tank, and overall results will vary significantly from day to day depending on how much water enters the tank.

Two-pipe tanks pose different challenges. With all the water going into, through, and out the tank, bypass problems are avoided. As a result, this type of tank may be a good location for a THM stripping system for a particular section of a city. The problem with these tanks, though, is that the SCADA water level records don't reflect the actual flow going through the tank at any one time; the tank level may not change even when 3,000 gpm of flow is going through it. As a result, other data must be used for determining the tank's flow rate in sizing a THM removal system.

Hydraulic Issues. New water is usually introduced at the bottom of a clearwell. Being slightly denser because of the pressure of water above it, the water flows across the bottom toward the outlet. New water entering a distribution tank, because it's usually cooler and denser than the older water in the tank, usually settles at the bottom. In short, regardless of the type of tank, the new water usually ends up at the bottom and is the first water to leave the tank, which poses a problem. If the THM stripping system doesn't pull water off the floor of the tank faster than water comes into the tank, inflow water will enter and then leave the tank later without ever being treated. For example, assume the incoming flow rate of a clearwell's untreated water is 3,000 gpm and the THM stripping system is pulling water off the floor at only 1,600 gpm. The result is 1,400 gpm of untreated water will either pass through the clearwell without ever being treated or else build up at the bottom. After an hour of these conditions, the untreated volume will be 84,000 gal, and this untreated water will usually be the first water to leave the clearwell. As the process repeats many times per day, the THM removal system's effectiveness is seriously compromised.

One solution to this problem is to design the THM removal system so its flow rate, plus supplemental mixers in the tank, always pull water off the floor at a rate that exceeds the inflow rate of untreated water into the tank, thereby ensuring no untreated water can flow into and out of the tank without being treated.



Spray aeration systems, available for virtually any size of water system, may be custom designed or formed from off-the-shelf equipment.

Other Design Concerns Chlorine boosting stations in the distribution system will increase THMs. Therefore, if possible, the THM stripping system should be located after the chlorine boost stations so more THMs can be stripped from the water.

Also, small spray nozzles in a spray aeration THM stripping system can become plugged from contaminants found in many drinking water systems (e.g., tar balls from old tank coatings, insect bodies, pieces of gaskets from flanges and pipes, pieces of reverse osmosis membranes, and other debris). The best way to solve plugging problems is to use nozzles with larger holes that will pass 0.25-in. solids or greater.

A VIABLE OPTION

Off-the-shelf THM removal systems are proven to solve THM compliance problems if fundamental design issues are considered. Many cities that flush lines to achieve temporary compliance at testing time would be better off to install an actual THM removal system instead. This would give residents consistently good water quality and prevent high volumes of treated water from being wasted. Off-the-shelf systems start at less than $20,000 and are available for virtually any size of water system.

RESOURCES

- AWWA Manual of Water Supply Practices M20: *Water Chlorination and Chloramination Practices and Principles*, 2006, catalog No. 30020.
- Duranceau, Steven J.; Smith, C. Tyler, 2016. Trihalomethane Formation Downstream of Spray Aerators Treating Disinfected Groundwater. *Journal AWWA,* 108:2:E99.