By Daryn Martin, Assistant General Manager / KRWA Technical Assistant

Pay Attention and Avoid Disinfection Byproducts (DBP) Violations

A look at KDHE's Public Water Supply Program Annual Compliance Report for Calendar Year 2021 (the most recent edition available on the agency's website (www.kdhe.ks.gov/526/Annual-Compliance-Reports) shows that 657 Public Water Suppliers sampled their distribution systems for Disinfection Byproducts (DBPs) as required by the Stage 2 Disinfectants/-Disinfection Byproducts Rule. Of those 657, 99.2 percent were compliant on Haloacetic Acids (HAA) and 97.1 percent were compliant with their Total Trihalomethanes (TTHM) results. Those are pretty good compliance numbers. According to the same report, in 2017 only 95.7 percent of systems were compliant on their HAA samples and a mere 92.8 percent were compliant with TTHM. It would appear that water systems are nailing down their disinfection and sampling practices.

DBPs are formed when disinfectants react with precursors in the water. The disinfectant to blame is usually chlorine but DBPs are also formed by other disinfectants like chloramine, ozone and chlorine dioxide. When the disinfectant reacts with the precursors (usually organic materials), these unwanted chemicals are formed. Scientists began to research DBPs in the mid-1970s. Numerous studies have shown associations between consuming water with elevated DBPs and an increased risk of bladder, stomach, colon and rectal cancers. There are, of course, studies that say the associations are not linked to DBPs in the drinking water, but to other environmental factors.

Most surface water treatment plants add ammonia to form chloramines and limit DBP formation.

It is generally accepted that DBPs begin forming the instant free chlorine is added to raw water and will continue to form as the disinfection process continues. This is problematic for many public water suppliers who purchase from a wholesale provider, especially if that wholesaler treats surface water. Almost all surface water treatment plants in Kansas have made changes to their treatment processes to limit DBP formation. This usually involved the addition of ammonia to form chloramines or by using an alternative disinfectant such as chlorine dioxide or ozone. Buyer beware: chlorine dioxide and ozone also form DBPs and have special monitoring tied to their use.

Compliance with Stage 2 Rule

What does compliance with the Stage 2 D/DBP Rule look like? The MCL for TTHM is 80 parts per billion (ppb) or micrograms per liter (μg/L). That is based on a Locational Running Annual Average (LRAA), which means all samples from the past 12 months collected from each particular location are averaged, and must be less than 80 ppb to be in compliance. A TTHM analysis measures the levels of four (4) individual "species" of trihalomethane chemicals. The process for determining compliance with HAA (sometimes

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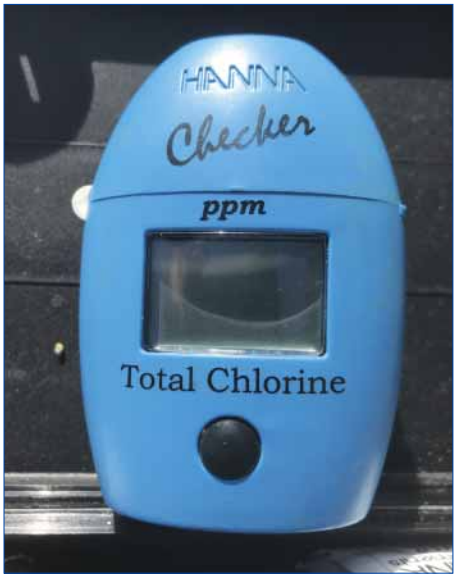
referred to as HAA5 or HAA_5) is very similar. Five (5) separate haloacetic acids are analyzed, the LRAA of which cannot exceed 60 ppb.

Let's take a quick look at the systems that measured DBP levels above EPA's limits. In the 2021 Report, 21 systems had a violation for exceeding the MCL at one or more LRAAs, 19 of the systems measured elevated THMs. Surprisingly, only five (5) of the systems had HAA violations. And, of those, only two (2) systems had only HAA violations, not THM. Both of those systems purchase water from a wholesaler that did not have DBP violations in 2021. In fact, six (6) of the water suppliers with a DBP violation purchased water from a wholesaler whose DBP levels were in compliance.

Of the three (3) systems that violated both TTHM and HAA in 2017, two (2) systems have undergone major water plant improvements at great expense to resolve the problems. The third is the city of Elmdale in beautiful Chase County, a special case near and dear to my heart. This very small town was very lucky to have an excellent operator who worked tirelessly to find a solution. You can read about it in the July 2022 issue of *The Kansas Lifeline*. That issue and all others are available on the KRWA website at https://krwa.net/ONLINE-RESOURCES/Lifeline-Magazine.



Every water system that purchases surface water should be equipped to monitor for both free and total chlorine. This unit from Hanna Instruments checks total chlorine levels. It is easy to use and very affordable.

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Occurrence of DBPs

The primary theory is that DBPs, specifically THMs, continue to increase as time goes on. Since KDHE requires all water systems to maintain minimum levels of chlorine, the theory goes that the disinfection process is ongoing until there is no more disinfectant. As disinfection continues, the byproducts of those chemical reactions continue to accumulate. The purchasing systems are sampling water that is days and sometimes weeks older than the water being sampled by the wholesaler.

DBP violations will occur in a purchasing system due to unmonitored or incorrect rechlorination practices. Many purchasing systems are equipped to rechlorinate, that is, add chlorine to the water. Adding free chlorine to water with chloramines in it is a very tricky business. If an operator is not diligent and extremely observant, things can get haywire quickly. It is very easy to add too much free chlorine, basically destroying monochloramines which were purposely formed to control DBPs by adding ammonia. Continuing to add free chlorine will form dichloramines causing undesirable taste and odors. Additional free chlorine being added will eventually reach breakpoint chlorination leaving free chlorine in the system. When free chlorine is present in the water, high DBPs are likely to follow.

The third obvious reason for these violations is collecting samples during a free chlorine burnout. Most surface water treatment plants will convert to free chlorine for extended periods of time to combat biofilm formation. See my article from July 2021's *The Kansas Lifeline* (Is there a theme here?) on sampling DBPs during a burnout. The conclusion? It is an idea best avoided.

Every system that purchases surface water should be equipped to monitor for both free and total chlorine. Good water operators also know their system's sampling schedule so they can anticipate when certain samples need to be collected. The idea is to know when the DBP samples need to be collected and plan for them.

To put it frankly, there are many DBP violations because the operator was not paying attention. I didn't even discuss the lunacy of Monitoring Violations (perhaps in another TKL issue). Every system that purchases surface water should be equipped to monitor for both free and total chlorine. Good water operators also know their system's sampling schedule so they can anticipate when certain samples need to be collected. The idea is to know when the DBP samples need to be collected and plan for them. If the water plant decides to undergo a free chlorine burnout, all of the purchasers need to plan DBP samples around that free chlorine-infused water. Before taking DBP samples, run some free chlorine tests alongside the total chlorine and compare the numbers. If there are high levels of free chlorine in the water, it might be a good idea to do some further investigating before collecting the DBP sample.

A lot of life's miseries can be avoided if one pays attention. Collecting DBP samples is like that, especially for purchasing systems. Paying attention to what the water treatment plant staff is doing and the quality of water provided will not circumvent all DBP violations, but it does take care of an easily avoidable violation due to sampling at an improper time.

Daryn Martin began work with KRWA in August 2019. He previously was a Water Program Inspector and Environmental Program Administrator at KDHE's Wichita office. Prior to joining KDHE, he worked as an operator in the El Dorado Water Treatment Plant. He holds a Class IV water operator certification.