

Tech Brief

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Simultaneous Compliance with Drinking Water Regulations

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Summary

Certain U.S. drinking water regulations—in particular the Stage 1 and 2 Disinfectants/Disinfection By-Products Rules and the Long-Term 1 and 2 Enhanced Surface Water Treatment Rules—have the potential to conflict with each other, as well as with other regulations such as the Lead and Copper Rule and the Total Coliform Rule. This means that small system operators cannot simply comply with these mandates individually, but must consider how changing their treatment process to meet one rule might affect compliance with other rules. This *Tech Brief* provides information and strategies to effectively comply with those regulations that are most likely to conflict with one another.

Whack-a-Mole

The term “simultaneous compliance” refers to a situation where addressing one regulation threatens compliance with a different regulation. This situation is reminiscent of the carnival game “Whack-a-Mole,” where the player tries to hit the rodent as it pops its head out of a hole, only to have another appear in a different hole.

With respect to simultaneous compliance, there are three areas of regulations that cause the most concern: (1) disinfection by-products rules (Total Trihalomethanes Rule, Stage 1 and Stage 2 Disinfection By-Products Rules), (2) surface water treatment rules (Interim Enhanced Surface Water Treatment Rule, Long Term 1 and Long Term 2 Enhanced Surface Water Treatment Rules), and (3) other rules (Lead and Copper Rule, Total Coliform Rule). Complying with any of these regulations can create the potential to conflict with one or more of the others.

Disinfection By-Products Overview

The original Total Trihalomethanes Rule (circa 1980) set a maximum contaminant level of 0.10 mg/l for trihalomethanes (TTHMs). The Stage 1 Disinfection By-Products Rule (DBPR) for systems serving fewer than 10,000 people went into effect on January 1, 2004, and lowered the TTHMs maximum contaminant level (MCL) to 0.080 mg/l and established a maximum contaminant level for haloacetic acids (HAA5) of 0.060 mg/l. This rule added the disinfection by-products chlorite and bromate, and established maximum

residual disinfectant levels (MRDLs) for chlorine (4 mg/l), chloramines (4 mg/l), and chlorine dioxide (0.8 mg/l). Removal requirements for total organic compounds and alkalinity were also included.

The Stage 2 DBPR was finalized in the *Federal Register* January 4, 2006, and featured three new components:

1. Combined Distribution System (CDS)
2. Initial Distribution System Evaluation (IDSE)
3. Location Running Annual Average (LRAA)

A CDS is defined as the interconnected distribution system consisting of the distribution systems of wholesale systems and of the consecutive systems that receive finished water.

Wholesale systems are public water systems that treat source water as necessary to produce finished water and then deliver some or all of that finished water to another public water system.

A consecutive system is a public water system that receives finished water from one or more wholesale systems. Compliance monitoring schedules for all systems within a CDS must be on the same schedule, based on the population of the individual public water system with the largest population within the CDS. The schedules are as follows:

- Schedule 1 = population 100,000 and above
- Schedule 2 = population 50,000 to 99,999
- Schedule 3 = population 10,000 to 49,999
- Schedule 4 = population under 10,000.



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The purpose of the IDSE is to determine where the high values of disinfection by-products are found in the distribution system and which month receives the highest readings. These location(s) will be your long-term sampling locations for TTHM and HAA5. IDSE requirements may be waived if a system meets one of two criteria:

- 40/30 Certification—eight consecutive calendar quarters with TTHMs and HAA5 equal to or less than 0.040 mg/l and 0.030 mg/l respectively beginning January 1, 2005, for schedules 3 and 4 (individual results, not averaged) and with no monitoring violations during the same period.
- Very Small System Waiver—systems that serve fewer than 500 people and that have sampled for TTHM and HAA5 under the Stage 1 DBPR.



Additional articles addressing the various regulations discussed in this *Tech Brief* are available on the National Environmental Services Center Web site at www.nesc.wvu.edu/ndwc.

Surface Water Treatment Overview

The Surface Water Treatment Rule was promulgated in 1989, and established new treatment techniques and minimum disinfection requirements. The turbidity requirements changed from an MCL to a treatment technique requiring grab samples every four hours. The Interim Enhanced Surface Water Treatment Rule (IESWTR), for systems that serve at least 10,000 persons, and the Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR), for systems that served less than 10,000 persons, went into effect January 1, 2005. There are very few differences between the requirements for these two rules. The Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) establishes different *Cryptosporidium* removal requirements depending upon the level of the pathogen in the source water. The schedule for monitoring with LT2ESWTR is based on the same premise as the Stage 2 DBPR.

Lead and Copper Rule Overview

The U.S. Environmental Protection Agency promulgated the Lead and Copper Rule in 1991 with the goal of minimizing lead and copper at users' taps. The action levels for lead and copper are 0.015 mg/l and 1.3 mg/l respectively at the 90th percentile of the samples measured. If the action levels are exceeded, test concurrently to see if the lead/copper is in the source water or from corrosive characteristics of the water.

Total Coliform Rule Overview

The Total Coliform Rule is intended to ensure that drinking water remains safe from microbial contaminants. Public water systems must collect a specific number of routine samples per month, depending on the population served. All utilities must develop a written bacteriological sampling plan that is subject to review and revision by the states.

Compliance Strategies

Simultaneous compliance issues most often arise between disinfection by-products rules and surface water treatment rules. The Stage 1 and Stage 2 DBPRs focus on minimizing the formation of disinfection by-products in the distribution systems through enhanced coagulation or enhanced softening to reduce exposure to these potentially carcinogenic compounds. The IESWTR, LT1ESWTR, and LT2ESWTR, on the other hand, focus primarily on achieving adequate disinfection and removal of pathogens to protect from acute pathogenic exposure that can cause outbreaks of waterborne disease.

Because the Stage 1 and 2 DBPRs are intended to minimize the formation of DBPs and residual disinfectants, this rule may conflict with surface water treatment rules (IESWTR, LT1ESWTR, LT2ESWTR), which specify levels of treatment techniques required for *Cryptosporidium* and *Giardia lamblia*. The rules infer that treatment at a level sufficient to eliminate these pathogens will also eliminate other pathogens and viruses. The primary idea is to control the disinfection by-products (keeping them at or below the MCL) and maintain adherence to the log removal requirements.

If a system is having problems with disinfection by-products, the first thing that it should do is microbial profiling and benchmarking. Disinfection profiling is a graphical representation of the system's level of *Giardia* or virus inactivation based on a compilation of daily or weekly (depending on the system size) *Giardia* and/or virus log inactivation over a period of a year or more. Most operators know this as the contact time calculations.

To construct a profile, collect the following data at the end of each process the same day of the week for systems serving fewer than 10,000 people or daily for systems serving more than 10,000 people for one year during peak hourly flow:

- temperature,
- disinfectant residual (if chlorine is used it is the free chlorine residual),
- disinfectant contact time, and
- pH (if chlorine is used as disinfectant).

This information is then entered in a spreadsheet for calculating the log inactivation. If chlorine is used, only a *Giardia* profile is required with a 3-log inacti-

vation. If other disinfectants are used, a virus profile is required with a 4-log inactivation, in addition to *Giardia* with a 3-log inactivation.

From the profiling, a benchmark can be established which is the lowest monthly value of *Giardia* log removal (and viruses, if required) based on the average of the measurements taken during that month. This benchmark is used as a tool by the state and system when a significant change in the disinfection practice is proposed. The state reviews the existing disinfection profile to ensure that the acute contaminant protection is not compromised.

Tricks of the Trade

Some techniques that can be used to control the disinfection by-products and maintain compliance with the log removal requirements of the surface water treatment rules are:

- Move the point of disinfection application (e.g., from raw water inlet point to post sedimentation). Some plants perform pre-disinfection and post-disinfection. Sometimes eliminating the pre-disinfection may do the trick. For purchaser systems that use disinfection at the tie-in point (connection point), moving the disinfection station down the line may help.
- Reduce the dosage of disinfection or modify the disinfection dosage under different temperature conditions.
- Change the type of disinfection used (e.g., from chlorine to chloramine). Other disinfectants include ozone and chlorine dioxide.
- Use UV disinfection for pre-disinfection.
- Use potassium permanganate as soon as possible in the treatment process. Potassium permanganate oxidizes iron and manganese, lowering the disinfectant dosage.
- Use peroxide to help oxidize difficult-to-treat organics.
- Change the contact basin geometry using baffling or increasing the pH prior to disinfection by greater than one unit (chlorine only).
- Change the raw water source. For purchasers, change the tie-in point or buy from a different source if available. Blending or alternating raw water sources, if possible, is another option.
- Add a booster disinfection station in problem areas instead of maintaining a high residual.
- Modify pre-sedimentation basin operations.
- Enhance coagulation.
- Enhance softening.
- Reduce the TOCs by installing a raw water settling basin or a pre-filter with granular activated carbon media or membrane filtration such as microfiltration/ultrafiltration or nanofiltration.
- Change the intake depth on the raw water inlet or alternate intake depth with seasonal changes.

- If a flushing program already exists, flush more often to keep the age of the water down. If no flushing program exists, start one. For a purchaser system, this may be the only alternative. For some systems, there may be just one area that has high disinfection by-products, and targeted flushing in the vicinity may work in this case.

A combination of all or any of the above strategies may be used. Remember to get prior approval from your state regulatory agency.

Systems should examine the impacts of any modifications they are considering. They should identify what information they need to help them decide whether to, or how they can, adjust their treatment to simultaneously comply with various regulations. If they do not have that information, they should identify what monitoring is necessary to obtain it. Adequately satisfying all parties—system owners, regulatory agencies, customers, and other stakeholders—is the end result of these considerations.

Tools for gathering information include:

- water quality monitoring,
- hydraulic and water quality modeling for distribution systems,
- desktop evaluations,
- bench-scale testing,
- pilot testing,
- full-scale applications,
- cost estimations, and
- community preferences.

When deciding how to comply, consider:

- production capability (systems operating at or near peak production capabilities are likely to be affected by decreases in production);
- compatibility with existing treatment facilities (any modification that changes the chemical properties of the water such as pH, alkalinity, metal concentrations, or organic matter concentration will likely affect the coagulation and sedimentation process);
- production of residuals and disposal issues (some process changes can affect the composition or cause the production of residuals or other wastes, and disposal of additional waste must be taken into account when determining costs and reviewing other considerations);
- site-specific issues (systems need to consider the number and skill of operators when making treatment decisions);

- compatibility with distribution system material (changes to water quality, especially to pH, alkalinity, or redox potential, can affect corrosion both in the plant and in the distribution system);
- compatibility with distribution system operations (systems may need to make distribution system changes, such as more frequent flushing to reduce residence times, to counter increased microbial activity);
- environmental issues (if a system needs to purchase new land for a treatment process or wants to change sources, environmental issues may arise such as the presence of wetlands or endangered species; discharges to a stream or surface water body, such as filter backwash water, well development water);
- consumer driven issues (changes in water rates require good communication); preference of operations staff (these preferences may be based on how chemicals are added, what forms of chemicals are used, the amount of automation, and positioning of equipment);
- consecutive system requirements (purchasing systems may have large distribution systems with long residence times. Water that is delivered may meet TTHM levels at delivery but may exceed them nearer the end of the distribution system); and
- cost (cost has an impact on decision about compliance strategies, but must include all of the previous considerations).

Compliance Strategies Continued

Obviously, meeting the compliance requirements for all the disinfection by-products rules and all the surface water treatment rules is no mean feat. But don't forget the Lead and Copper Rule and Total Coliform Rule. Changing any process or procedure with the previously mentioned items could create problems when addressing these rules. Conflicts can occur when the chemical stability of drinking water is affected.

For lead and copper, the typical treatment is to control corrosion by either changing the existing water chemistry in the distribution system to establish a protective film (pH/alkalinity manipulation) or adding a chemical to the clear-well that will add a film of protection on the piping to prevent corrosion (e.g., polyphosphates).

When selecting a lead and copper corrosion control strategy, it is important to understand the chemistry of finished water. Important water

quality parameters influencing lead and copper corrosion include pH, alkalinity, water hardness, temperature, minerals in the water, and several other factors.

A common example for noncompliance with the Lead and Copper Rule is when certain actions make it necessary for water systems to comply with all the disinfection by-products by such means as enhanced coagulation. This can upset the established operating chemistry in a system by lowering the pH. The lower pH can cause lead and/or copper to leach into the water from materials that exist in the plumbing of the customer's services lines or homes.

For the Total Coliform Rule, gone are the days when an operator could simply maintain the maximum disinfectant residual concentration in the distribution system with some adjustments for customer complaints. Dealing with all the disinfection by-products rules, all the surface water treatment rules, the Lead and Copper Rule, and maintaining protection against microbial contamination, require the operator and system managers to look at all aspects of the system and how one change could effect other rules.

For More Information

The U.S. Environmental Protection Agency's *Microbial and Disinfection Byproducts Rules Simultaneous Compliance Guidance Manual* provides detailed information about the issue discussed in this article. Order a copy of this manual by calling the National Environmental Services Center at (800) 624-8301 or by sending an e-mail to info@mail.nesc.wvu.edu. Request product #DWBKRG61.

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