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Treatment Optimization—

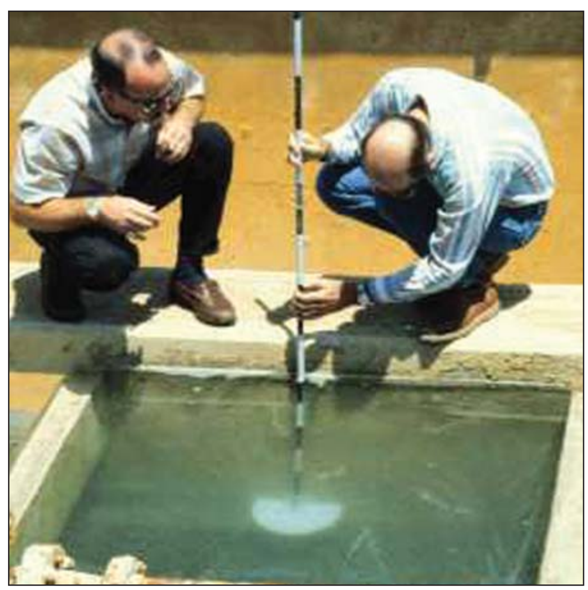
Providing More Effective Multiple-barrier Protection

Reducing the public health risk from waterborne disease relies primarily on drinking water treatment systems of all types providing multiple barriers of protection from the passage of contaminants between the source water and the consumer. To ensure that the nation's drinking water suppliers provide effective multiple barriers to protect public health, Congress has mandated that the US Environmental Protection Agency (USEPA) develop and implement various drinking water regulations.

The Standards and Risk Management Division within USEPA's Office of Ground Water and Drinking Water (OGWDW) has the responsibility to develop drinking water regulations. During the past 30 years, JOURNAL AWWA has provided its readers with large amounts of information on the regulations that have been developed and the water industry's involvement in the process. However, many of those reading the JOURNAL may not realize that USEPA has another program for enhancing water system multiple-barrier protection—the treatment optimization program.

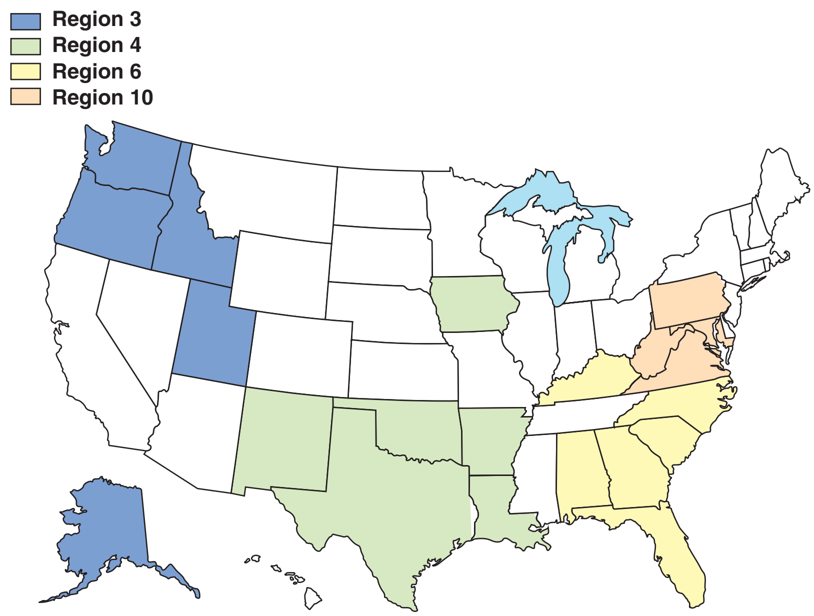
The treatment optimization program operates as part of OGWDW's Technical Support Center (TSC) in Cincinnati, Ohio. The Association of State Drinking Water Administrators also plays a key role in advocating the development of optimization programs within state regulatory programs.

The program started in 1989, focusing on the development of the comprehensive performance evaluation (CPE) to assist filtration plants in complying with the turbidity requirements of the then recently promulgated Surface Water Treatment Rule (SWTR). Development of the CPE procedures showed that most water systems could easily comply with the SWTR using existing facilities while they also achieved optimized levels of performance.


Assessing the status of key filtration operational parameters, including appropriate expansion of media during backwash (as seen here), is an integral element of activities targeted toward optimizing turbidity performance.

As it evolved, the program identified a need to establish programs within state regulatory agencies in order to effectively achieve a broad level of acceptance and a commitment on the part of water systems to pursue optimization. TSC works through four USEPA regional offices to facilitate development of area-wide optimization programs (AWOPs) in the 21 states shown in Figure 1.

FIGURE 1 AWOPs in 21 states are administered through four US Environmental Protection Agency regional offices



AWOPs—area-wide optimization programs

Regional offices in regions 3 and 4 administer the nearby AWOP programs in Utah (Region 8) and Iowa (Region 7), respectively.

TREATMENT OPTIMIZATION FUNDAMENTALS

Treatment optimization programs encourage water systems to voluntarily pursue optimized performance goals (which are typically levels of water quality that exceed the regulations) because it is believed they provide enhanced multiple-barrier protection. Water systems involved in optimization focus on achieving these goals using existing staff and treatment processes. All approaches to optimization use enhanced treatment process monitoring and control, with only minor modifications being made to treatment systems.

Treatment process monitoring takes on a slightly different role within the context of optimization. Instead of simply documenting regulatory compliance, these data are entered into special optimization-focused spreadsheets that provide various tables and graphs that water system staff can use to make process control decisions, solve problems, and enhance basic operational procedures. Being able to "draw the graph" showing certain parameters for water system performance can lead to an attitude of continuous improvement throughout all levels of a water system's staff.

States that want to encourage their water systems to implement these optimization principles collaborate with other states through one of the four USEPA regional offices with a multistate AWOP (Figure 1). USEPA facilitates the development of each state's AWOP by providing training in optimization tools and helping resolve institutional issues that may be preventing an AWOP from being successful.

In implementing its AWOP, a state first prioritizes all of its water systems according to a public health risk assessment for each system—a priority list that is then used for targeting appropriate followup activities. Followup can include routine state activities or a specialized optimization approach that the state considers appropriate for a particular water system. State AWOPs realize that there are differences among water systems and that a one-size-fits-all approach is inappropriate. They also believe that unless a water system can "draw the graph" and show improved performance, the state's assistance has not been effective.

THE VALUE OF OPTIMIZATION

Readers of this column may believe that their water systems or states currently do an excellent job within the regulatory framework and would not benefit from pursuing optimization. However, optimization, as defined previously, represents a new way of doing business that can add value for water systems as well as state regulators.

Because of the training provided and the voluntary nature of an

AWOP, a state creates a unique environment for its water systems that helps build professional relationships and encourages optimization. Usually, a state focuses its assistance on helping a water system solve its own performance problems. AWOP states do not function as troubleshooters—acting as if they have all the answers and then leaving. They understand the value of helping people acquire the skills needed to identify the possible causes of performance problems, study potential solutions, and implement the best solution—and to "draw the graph" to show success. Building these skills creates a long-term capability throughout a water system for sustaining optimized performance; it also has the potential for lessening the effect of staff turnover.

AWOP states can enhance this environment in other ways. During annual inspections, a state can have a discussion with a water system about the basis it uses for the relative optimization ranking statewide. If statewide optimization meetings are held, water systems can share information. AWOP states can also look for opportunities to integrate a water system's optimization efforts with the activities of other state programs (e.g., operator certification) so that they complement one another.

Developing an AWOP can enhance the skills of a state's staff because they learn how to use a variety of unique tools to facilitate the optimization of water systems in their state. Some of the technical tools used in an AWOP include the following:

Composite correction program. This program, which helps systems identify and correct a situation limiting performance, represents the foundation of all optimization activities. The program also serves as the basis for the self-assessment procedures of the Partnership for Safe Water. Training on the CPE procedures provides an in-depth understanding of turbidity optimization.

Optimization assessment spreadsheet (OAS). The OAS is an Excel® spreadsheet used by states and water systems to monitor and track the performances of individual sedimentation basins and filters. This spreadsheet generates various graphs and tables that are used to assess a water system's performance against optimization performance goals and to identify possible causes of performance problems.

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Performance-based training (PBT). Through PBT, an AWOP state facilitates development of the key skills a water system's staff needs in order to achieve optimized performance. In PBT, up to six water systems participate in five one-day training sessions over a 12-month period. Each session includes a homework assignment that trainees complete prior to the next session (at which they report their findings to the entire group). During PBT, a water system's staff learns how to:

- monitor treatment processes using the OAS,
- interpret data to assess performance problems and prioritize activities,
- use special study procedures to identify causes of performance problems,
- calibrate jar test procedures to reflect a specific plant, and
- use data to build staff and management support for optimization.

A broad goal of AWOP is to develop an infrastructure to ensure that states have a staff with a strong basic understanding of optimization principles. Sustaining the program for the long term involves providing the state staff with the new technical tools necessary for responding to changing drinking water program priorities (e.g., new contaminants and regulations). With a strong human infrastructure in place, states can quickly provide their water systems with the latest optimization information to further strengthen multiple-barrier protection; the information can also be incorporated into a state's operator training and other programs.

Some initial efforts have been made to explore the potential of formalizing the integration of optimization principles into other drinking water program activities. The goal is to find areas in which optimization and these drinking water programs can complement each other—ultimately leading to better water system performance.

USEPA is also currently working to expand its optimization efforts in a number of new areas, including

Disinfection by-product (DBP) CPE. This CPE procedure focuses on in-plant control of DBPs. Included within it are spreadsheets for constructing trends from a system's historical data, special studies to evaluate DBP control, and identification of potential DBP control strategies. Along with assessing a plant

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with respect to optimization performance goals for disinfection, total organic carbon removal, and DBPs, the CPE also considers performance data related to any possible secondary effects from controlling DBPs.

PBT for DBPs. A PBT approach for the transferring of skills for control of DBPs and the optimization of DBP treatment is under development. Although generally based on the microbial PBT model, the training sessions will have a focus that is more in line with the DBP CPE.

Distribution system optimization. Initial activities in this area are exploring how to assess the effect of distribution system operations on DBPs. Preliminary procedures are under development for assessing areas of the distribution system with potentially high DBPs based on chlorine residual. Preliminary distribution sampling methods, monitoring procedures, and spreadsheets have been developed. Procedures for assessing the effects of storage tank operation on water quality are also being explored.

Groundwater optimization. An overall approach for optimizing groundwater systems that treat for microbial contaminants has been developed in conjunction with USEPA's Region 6. Preliminary optimization goals are being developed, along with a CPE procedure to identify such areas of concern as the source water, the amount of disinfection provided, and the distribution system.

CONCLUSION

Water system personnel understand the importance of providing multiple-barrier protection between their source water and their customers. USEPA, working in conjunction with state governments, is responsible for ensuring that these barriers are effective—and does so primarily through implementation of regulations and other drinking water program activities. The voluntary (and complementary) treatment optimization approach supported by USEPA provides both states and water systems with an opportunity to enhance multiple-barrier protection by improving the performance of existing facilities through enhanced process monitoring and control.

The treatment optimization program has demonstrated that its technical materials and implementation approach can have a real, measurable impact on water system performance. For example, when South Carolina started its AWOP program in 1998, only 50,000 people in the state received water from systems with a turbidity of less than 0.1 ntu. By 2005—largely attributable to the efforts of the state optimization program—two million people were receiving water of such quality. In addition to improved performance, those states and water systems involved with optimization now have a mechanism in place that enhances and sustains the skills of staff. USEPA is also supporting the development of enhancements to its optimization program that will address key issues facing drinking water systems. USEPA encourages both states and water systems to learn more about the program and find out how they can advance public health protection through optimized performance.

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