

Stage 1 Disinfectants and Disinfection Byproducts Rule

In the past 25 years, the Safe Drinking Water Act (SDWA) has been highly effective in protecting public health and has also evolved to respond to new and emerging threats to safe drinking water. Disinfection of drinking water is one of the major public health advances in the 20th century. One hundred years ago, typhoid and cholera epidemics were common through American cities; disinfection was a major factor in reducing these epidemics.

However, the disinfectants themselves can react with naturally-occurring materials in the water to form unintended byproducts which may pose health risks. In addition, in the past 10 years, we have learned that there are specific microbial pathogens, such as *Cryptosporidium*, which can cause illness, and is highly resistant to traditional disinfection practices.

Amendments to the SDWA in 1996 require EPA to develop rules to balance the risks between microbial pathogens and disinfection byproducts (DBPs). It is important to strengthen protection against microbial contaminants, especially *Cryptosporidium*, and at the same time, reduce potential health risks of DBPs. The Stage 1 Disinfectants and Disinfection Byproducts Rule and Interim Enhanced Surface Water Treatment Rule, announced in December 1998, are among the first of a set of rules under the 1996 SDWA Amendments. This fact sheet focuses on the Stage 1 Disinfectants and Disinfection Byproducts Rule. A separate fact sheet focuses on the Interim Enhanced Surface Water Treatment Rule (EPA 816-F-01-013).

PUBLIC HEALTH CONCERNS

While disinfectants are effective in controlling many microorganisms, they react with natural organic and inorganic matter in source water and distribution systems to form DBPs. Results from toxicology studies have shown several DBPs (e.g., bromodichloromethane, bromoform, chloroform, dichloroacetic acid, and bromate) to be carcinogenic in laboratory animals. Other DBPs (e.g., chlorite, bromodichloromethane, and certain haloacetic acids) have also been shown to cause adverse reproductive or developmental effects in laboratory animals. Several epidemiology studies have suggested a weak association between certain cancers (e.g., bladder) or reproductive and developmental effects, and exposure to chlorinated surface water. More than 200 million people consume water that has been disinfected. Because of the large population exposed, health risks associated with DBPs, even if small, need to be taken seriously.

WHO MUST COMPLY WITH THE RULE?

The Stage 1 Disinfectants and Disinfection Byproducts Rule applies to all community and nontransient noncommunity water systems that add a chemical disinfectant in any part of the drinking water treatment process and transient NCWSs using chlorine dioxide.

WHAT DOES THE RULE REQUIRE?

The Stage 1 Disinfectants and Disinfection Byproduct Rule updates and supersedes the 1979 regulations for total trihalomethanes. In addition, it will reduce exposure to three disinfectants and many disinfection byproducts.

The rule establishes maximum residual disinfectant level goals (MRDLGs) and maximum residual disinfectant levels (MRDLs) for three chemical disinfectants—chlorine, chloramine and chlorine dioxide (see Table 1). It also establishes maximum contaminant level goals (MCLGs) and maximum contaminant levels (MCLs) for total trihalomethanes, haloacetic acids, chlorite and bromate (see Table 1).

Table 1
MRDLGs, MRDLs, MCLGs and MCLs for Stage 1 Disinfectants
and Disinfection Byproducts Rule

Disinfectant Residual	MRDLG (mg/L)	MRDL (mg/L)	Compliance Based On
Chlorine	4 (as Cl ₂)	4.0 (as Cl ₂)	Annual Average
Chloramine	4 (as Cl ₂)	4.0 (as Cl ₂)	Annual Average
Chlorine Dioxide	0.8 (as ClO ₂)	0.8 (as ClO ₂)	Daily Samples
Disinfection Byproducts	MCLG (mg/L)	MCL (mg/L)	Compliance Based On
Total trihalomethanes (TTHM) ¹	N/A	0.080	Annual Average
- Chloroform	N/A		
- Bromodichloromethane	zero		
- Dibromochloromethane	0.06		
- Bromoform	zero		
Haloacetic acids (five) (HAA5) ²	N/A	0.060	Annual Average
- Dichloroacetic acid	zero		
- Trichloroacetic acid	0.3		
Chlorite	0.8	1.0	Monthly Average
Bromate	zero	0.010	Annual Average

N/A Not applicable because there are individual MCLGs for TTHMs or HAAs.

1 Total trihalomethanes is the sum of the concentrations of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

2 Haloacetic acids (five) is the sum of the concentrations of mono-, di-, and trichloroacetic acids and mono- and dibromoacetic acids.

Water systems that use surface water or ground water under the direct influence of surface water and use conventional filtration treatment are required to remove specified percentages of organic materials, measured as total organic carbon (TOC), that may react with disinfectants to form DBPs (See Table 2). Removal will be achieved through a treatment technique (enhanced coagulation or enhanced softening) unless a system meets alternative criteria.

**Table 2
Required Removal of Total Organic Carbon by Enhanced Coagulation and Enhanced Softening for
Subpart H Systems Using Conventional Treatment¹**

Source Water TOC (mg/L)	Source Water Alkalinity (mg/L as CaCO ₃)		
	0-60	>60-120	>120 ²
>2.0-4.0	35.0%	25.0%	15.0%
>4.0-8.0	45.0%	35.0%	25.0%
>8.0	50.0%	40.0%	30.0%

1-Systems meeting at least one of the alternative compliance criteria in the rule are not required to meet the removals in this table.

2-Systems practicing softening must meet the TOC removal requirements in the last column to the right.

WHAT ARE THE COMPLIANCE DEADLINES?

Surface water systems and systems using ground water under the direct influence of surface water serving 10,000 or more people are required to comply with the Stage 1 Disinfectants and Disinfection Byproducts Rule by January 1, 2002. All ground water systems and systems using surface water or ground water under the direct influence of surface water serving less than 10,000 people must comply with the Stage 1 Disinfectants and Disinfection Byproducts Rule by January 1, 2004.

WHAT ARE THE COSTS AND BENEFITS OF THE RULE?

EPA estimates that implementation of the Stage 1 Disinfectants and Disinfection Byproducts Rule will result in:

- 1- As many as 140 million people receiving increased protection from DBPs.
- 2- 24 percent national average reduction in TTHM levels.
- 3- Reduction in exposure to the major DBPs from use of ozone (bromate) and chlorine dioxide (chlorite).

The total annual cost of the rule is about \$700 million. EPA believes that the benefits exceed the costs of the Stage 1 Disinfectants and Disinfection Byproducts Rule. An estimated 115 million households are affected by the Stage 1 Disinfectants and Disinfection Byproducts Rule. EPA estimates that 95 percent of the households will incur additional costs of less than \$1 per month on their water bills. An additional four percent will pay between \$1 and \$10 per month more, and one percent are expected to incur increased water bills of \$10 to \$33 per month, if they choose to install treatment. However, many of these systems may chose less costly non-treatment options, such as consolidation. The majority of households incurring the highest costs are small systems serving less than 10,000 people that have never been regulated for DBPs.

WHAT TECHNICAL INFORMATION WILL BE AVAILABLE ON THE RULE?

A series of guidance manuals have been developed to support the Stage 1 Disinfectants and Disinfection Byproducts Rule. The manuals will aid EPA, state agencies and affected public water systems in implementing the Stage 1 DBPR. The guidance manual are available on EPA's website at www.epa.gov/safewater/mdbp/implement.html.

Guidance Manual for Enhanced Coagulation and Enhanced Precipitative Softening

Objective: To assist utilities in implementing, monitoring, and complying with the treatment technique requirements in the final Stage 1 Disinfectants and Disinfection Byproducts Rule and to provide guidance to state staff responsible for implementing the treatment requirements.

Contents: The manual provides detailed information on the total organic carbon (TOC) removal requirement; explains how to set an alternative TOC removal percentage under the Step 2 procedure; details monitoring, reporting, and compliance requirements; and discusses strategies that can be employed to mitigate the potential secondary effects on plant performance due to implementation of the treatment technique.

Alternative Disinfectants and Oxidants Guidance Manual

Objective: To provide technical data and engineering information on disinfectants and oxidants that are not as commonly used as chlorine, so that systems can evaluate their options for developing disinfection schemes to control water quality problems such as zebra mussels and Asiatic clams, and oxidation to control water quality problems associated with iron and manganese.

Contents: The manual discusses six disinfectants and oxidants: ozone, chlorine dioxide, potassium permanganate, chloramines, ozone/hydrogen peroxide combinations, and ultraviolet light. A decision tree is provided to assist in evaluating which disinfectant(s) is most appropriate given certain site-specific conditions (e.g., water quality conditions, existing treatment and operator skill). The manual also contains a summary of existing alternative disinfectants use in the United States and cost estimates for the use of alternative disinfectants.

M/DBP Simultaneous Compliance Manual

Objective: To assist public water systems on complying simultaneously with various drinking water regulations (e.g., Stage 1 Disinfectants and Disinfection Byproducts Rule, Interim Enhanced Surface Water Treatment Rule, Lead and Copper Rule and the Total Coliform Rule). The manual discusses operational problems systems may encounter when implementing these rules.

Contents: The manual provides detailed information on the requirements in the Stage 1 Disinfectants and Disinfection Byproducts Rule and the Interim Enhanced Surface Water Treatment Rule and issues involved with simultaneously complying with other rules.

For more information, contact EPA's Safe Drinking Water Hotline, 1.800.426.4791, or see the Office of Ground Water and Drinking Water web page at <http://www.epa.gov/safewater/standards.html>.