January 2009
Version 1

Quick Guide

Disinfection Byproduct Precursors

Colorado Department of Public Health and Environment

PROVIDED TO PUBLIC WATER SYSTEMS FROM THE COMPLIANCE ASSURANCE SECTION OF THE WATER QUALITY CONTROL DIVISION

Purpose

This treatment technique was established because disinfectants can react with naturally occurring organic matter to form both regulated and un-regulated disinfection byproducts. The treatment technique is designed to provide public health protection by minimizing the production of all disinfection byproducts.

Sampling Tips

- Allow a lag-time between the raw and treated water TOC samples to represent the detention time of the treatment train between the sample points.
- Collect the finished water TOC sample at a point no later than the point of combined filter effluent.

Common Reasons for Noncompliance

- Plant operation is not optimized
- Monitoring incorrectly
- Raw sample mislabeled as treated sample
- Raw water is difficult to treat

EPA Guidance Documents

- *Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual* (EPA 815-R-99-12) May 1999
- *STEP Guide - Complying with the Stage 1 Disinfectants and Disinfection Byproducts Rule: Supplement B* (EPA 816-B-05-006) March 2006

Questions?

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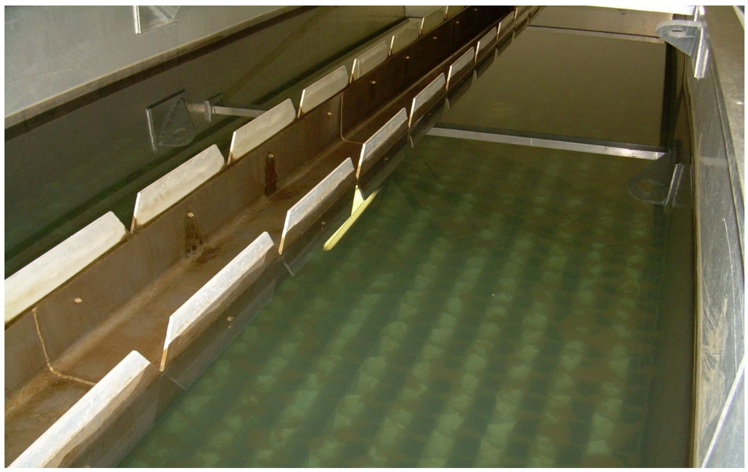

Sedimentation basin. Photo by David Dani.

Overview of the Disinfection Byproduct Precursor Treatment Technique Requirements

Colorado Primary Drinking Water Regulations **Articles7.6.3(d), 7.6.5(d) and 7.6.6**

- Applicability: Public water system plants using conventional surface water treatment are required to operate with enhanced coagulation or enhanced precipitative softening to remove total organic carbon (TOC). Conventional treatment is defined as coagulation, flocculation, sedimentation and filtration resulting in substantial particulate removal. Other surface water treatment types and all ground water treatment types are excluded from this requirement because their source waters generally are expected to have lower TOC and/or the treatment trains typically are not configured to allow significant TOC removal.
- Collect Data: Every month, collect one alkalinity sample from raw water, one TOC sample from raw water and one TOC sample from finished water.
- Step 1: Use the collected data to calculate the removal ratio for that month using the "3x3 Table" and any substitutions. (See reverse for more details.) Calculate the running annual average (RAA) of removal ratios. If the RAA is 1.00 or greater, the system is in compliance.
- Alternatives: If the system meets one of the criteria listed in Article 7.6.6 (a), the plant is not required to operate with enhanced coagulation or enhanced precipitative softening and is considered in compliance with the treatment technique. (See reverse for more details.)
- Report to the division within 10 days of the end of each calendar quarter.
- Step 2: If the raw water is not amenable to enhanced coagulation, the system must perform TOC jar testing to define a point of diminishing return. The water system may then apply for an alternative TOC removal requirement. (See reverse for more details.)

How to Calculate TOC Removal

Compliance is determined at the end of each calendar quarter.

(a) For each month, determine actual monthly TOC percent removal, equal to- (1-(treated water TOC / raw water TOC) x 100.
(b) For each month, determine the required monthly TOC percent removal from the "3x3 Table" found in Article 7.6.6(b)(2) or use the alternative level approved by the division through Step 2 jar testing.
(c) Divide "a" above by "b" above. This is your *monthly* removal ratio. If this ratio is less than 1.00, you may substitute 1.00 for your *monthly* removal ratio if the data collected *in that month* meets the criteria listed in Article 7.6.6(c)(2).
(d) Add together the results from "c" for the last 12 months and divide by 12. This is your removal ratio RAA. If the RAA is 1.00 or greater, the system is in compliance with the TOC percent removal requirement. (If a plant operated less than 12 months, the RAA is calculated with available data).

Sedimentation in a conventional treatment plant. Photo by Dwain Watson.

Alternative Compliance Criteria (ACC)

Certain waters are less amenable to TOC removal. For this reason, ACC have been developed to allow plants flexibility for establishing compliance with the treatment technique. These criteria recognize the low potential of certain waters to produce disinfection byproducts, and also account for those waters not amenable to good TOC removal.

Plants that meet the treatment technique using any of the ACC do not have to operate with enhanced coagulation or enhanced precipitative softening. *TOC and alkalinity monitoring still must be performed.*

Summary of ACC listed in Article 7.6.6 (a)-
(1) Raw water TOC < 2.0 mg/L as a RAA.
(2) Treated water TOC < 2.0 mg/L as a RAA.
(3) Raw water TOC < 4.0 mg/L as RAA <u>and</u> raw water alkalinity > 60 mg/L as RAA <u>and</u> TTHM and HAA5 RAAs in the distribution system are ≤ 0.040 mg/L and 0.030 mg/L, respectively.
(4) TTHM and HAA5 RAAs in the distribution system are ≤ 0.040 mg/L and 0.030 mg/L, respectively <u>and</u> the system uses only chlorine as a primary and residual disinfectant.
(5) Raw water SUVA ≤ 2.0 L/mg-m as a RAA.
(6) Treated water SUVA ≤ 2.0 L/mg-m as a RAA.
(7) Treated water alkalinity < 60 mg/L as a RAA (softening systems only).
(8) Plant removes ≥ 10 mg/L of magnesium hardness as a RAA (softening systems only).

Specific Ultraviolet Absorption (SUVA)

SUVA is an indicator of the humic content of the water. Waters low in SUVA values contain primarily non-humic organic matter and are not amenable to enhanced coagulation. On the other hand, waters with high SUVA values generally are amenable to enhanced coagulation.

SUVA monitoring is optional. Plants having a difficult time complying with the treatment technique should begin collecting SUVA data as soon as possible to evaluate if it can be used to establish compliance. Systems may use SUVA data as a monthly 1.00 ratio substitution criterion when calculating their TOC removal ratio <u>and/or</u> for compliance with ACC (5) or (6) on a RAA.

A description of SUVA monitoring protocol can be found in Article 10.7.4(d).

Step 2 Jar Testing

A few plants will not be able to achieve the required TOC removals or comply with the ACC due to unique water quality characteristics. The purpose of Step 2 jar testing is to establish an alternative TOC removal requirement for that plant. Under the Step 2 protocol, 10 mg/L increments of alum are added to determine the incremental removal of TOC. The point of diminishing return (PODR) is the point on a TOC removal vs. coagulant dose plot where the slope becomes less than 0.3/10 . The percent TOC removed at the PODR is the alternative percent TOC removal requirement, subject to approval by the division. Once the alternative requirement is defined and approved by the division, the system is free to achieve it in full-scale with any combination of coagulant, coagulant aid, filter aid, acid, etc.

Systems wishing to begin Step 2 jar testing must apply to the division before beginning this procedure. The division will supply the system with detailed instructions and reporting forms.

Plant Optimization

Plants having a difficult time complying with the treatment technique should perform TOC jar testing to evaluate modifications to coagulant type, coagulant dose, pH conditions and other chemical or operational practices. These jar tests will help the operator decide if the plant can be optimized to improve compliance or if Step 2 jar testing is necessary. Plants that simply wish to improve their TOC removal also may wish to perform jar testing periodically.

Performing TOC jar testing in the Colorado Rural Water Association mobile trailer for Norwood Water Commission, Norwood, Colo. Jocelyn Mullen, Water Quality Control Division, and Tim Lippert, Norwood Water Commission, pictured. Photo by David Dani.