Disinfectants and Disinfection Byproducts Rule (Stage 1&2 DBPRs)

Wyoming Potable Water Age, Lagoon Aeration and Utility Line Replacement Seminar
Hosted by Water Quality Division, Wyoming DEQ

• Mary Wu
  • Environmental Engineer
  • EPA Region 8
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WHY DBPR?

• **Purpose of Disinfection** - To Kill or to inactivate disease-causing microorganisms that cause serious illness and death (for example: typhoid, hepatitis, and cholera)

• **Disinfection Byproducts** - Disinfectants react with naturally occurring materials in the water (e.g., natural organic matter, bromide, or DBP precursors) to form unintended disinfection by-products (DBPs)
Risk-Risk Trade off
A Delicate Balance

Microbes

Disinfection Byproducts
• Stage 1 DBPR - promulgated on December/16/1998

• Stage 2 DBPR - promulgated on January/04/2006
Stage 1 DBPR Components

• Set Maximum Residual Disinfectant Levels (MRDLs) for chlorine, chloramines & chlorine dioxide
• Set MCLs for TTHM, HAA5, bromate & chlorite
• Enhanced coagulation requirement for conventional filtration to remove DBP precursors
• Stage 1 Monitoring Plan
High HAA5 concentration
Stage 2 DBPR Components

- Consecutive systems - regulated
- Compliance calculation - locational RAA (LRAA)
- DBP monitoring - at the highest DBP locations
- Sampling frequency - population based
- Precision of certified Lab (MDLs and acceptance limits)
Combined Distribution System (CDS)

- Interconnected distribution system consisting of the distribution systems of wholesale systems and of the consecutive systems that receive finished water
IDSE - Stage 2 DBPR
Early Implementation

Community* PWSs must conduct an Initial Distribution System Evaluation (IDSE) and use its results in conjunction with the Stage 1 monitoring results to find the highest DBP locations for the stage 2 compliance sampling sites.
IDSE Options

- Very Small System Waiver (VSS) – no IDSE plan required
- 40/30 Certification – no IDSE plan required
- Standard Monitoring
- System Specific Study
### Stage 2 DBPR Schedules

<table>
<thead>
<tr>
<th>Schedule</th>
<th>Largest Service Population within a CDS</th>
<th>IDSE Report Due by</th>
<th>Stage 2 Compliance Monitoring Starts on</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>≥ 100,000</td>
<td>1/01/2009</td>
<td>4/01/2012</td>
</tr>
<tr>
<td>#2</td>
<td>50,000 - 99,999</td>
<td>7/01/2009</td>
<td>10/01/2012</td>
</tr>
<tr>
<td>#3</td>
<td>10,000 - 49,999</td>
<td>1/01/2010</td>
<td>10/01/2013</td>
</tr>
<tr>
<td>#4</td>
<td>&lt; 10,000</td>
<td>7/01/2010</td>
<td>10/01/2013*</td>
</tr>
</tbody>
</table>
## Stage 2 DBPR TTHM/HAA5 Routine Monitoring Table

<table>
<thead>
<tr>
<th>Source Water Type</th>
<th>Population size</th>
<th>Monitoring frequency</th>
<th>Monitoring period</th>
<th>Distribution system monitoring location</th>
<th>Existing Stage 1 compliance location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total per monitoring period</td>
<td>Highest TTHM locations</td>
</tr>
<tr>
<td>Subpart H</td>
<td>&lt;500</td>
<td>per year</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>500-3,300</td>
<td>per quarter</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3,301-9,999</td>
<td>per quarter</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>10,000-49,999</td>
<td>per quarter</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>50,000-249,999</td>
<td>per quarter</td>
<td>8</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Ground Water</td>
<td>&lt;500</td>
<td>per year</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>500-9,999</td>
<td>per year</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>10,000-99,999</td>
<td>per quarter</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>100,000-499,999</td>
<td>per quarter</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

1. All systems must monitor during month of highest DBP concentrations.
2. Systems on quarterly monitoring must take dual sample sets every 90 days at each monitoring location, except for subpart H systems serving 500-3,300. Systems on annual monitoring and subpart H systems serving 500-3,300 are required to take individual TTHM and HAA5 samples (instead of a dual sample set) at the locations with the highest TTHM and HAA5 concentrations respectively. Only one location with a dual sample set per monitoring period is needed if highest TTHM and HAA5 concentrations occur at the same location, (and month, if monitored annually).
Important Notes

- Stage 2 only replaces TTHM/HAA5 part of the Stage 1
- PWSs must continue to monitor TTHM/HAA5 under the Stage 1 until Stage 2 compliance date starts
- PWSs must develop a Stage 2 Monitoring Plan at least 6 months before starting Stage 2 monitoring and submit it to EPA for approval
- IDSE Report can be used as a substitute for Stage 2 Monitoring Plan
Enhanced Coagulation

The addition of sufficient coagulant to improve removal of disinfection byproduct precursors (TOC) by conventional filtration treatment

Required TOC removal % is based on source water TOC and alkalinity (3x3 matrix for TOC removal – Step 1)
BAT for TTHM/HAA5

- GAC 10 – Granular activated carbon filter beds with an empty-bed contact time of 10 minutes based on average daily flow and a carbon reactivation frequency of every 120 days
- GAC20
- Nanofiltration (NF) – Membrane molecular weight cutoff of 1000 Daltons or less
- Chloramination – for consecutive systems
Strategies to Reduce TTHM/HAA5

• Improve precursor (TOC) removal – EC/ES, oxidant addition
• Adjust finished water pH
• Reduce water age in the distribution system
• Move chlorination point to later in the treatment process
• Change disinfectant – $O_3$, $ClO_2$, $Cl_2$, UV, or Chloramines
Recommendations

- Conduct a pilot study on site during high risk period to evaluate TOC removal capability of the proposed treatment improvement.
- Perform finished water DBP formation potential to evaluate proposed treatment performance in meeting the DBP requirement.
Options to Reduce DBPs

- Operational changes (less costly)
- Equipment changes (capital improvements)
Operational Changes

- Chemical Dosage Optimization - Enhanced Coagulation (EC)
- Distribution System Flushing Program
- Water Age Reduction
Chemical Optimization

Optimize chemical dosage to remove DBP precursors (total organics) –
Enhanced Coagulation

- **Required** for systems using conventional filtration as the final filtration barrier
- **Recommended** for the rest of subpart H water systems
Distribution System Cleaning and Flushing Program

Regular cleaning and flushing program in the distribution system to remove accumulated sediments and stagnant organic material/biofilm that is reacting with the disinfectant to form DBPs.
Water Age Reduction

- Stagnant water or long detention time promotes loss of chlorine residual, and higher DBP formation
- Recommendations:
  Clean tanks at least once/5 years
  Turn over 30 to 50% of tank storage daily
  Keep less than 5 to 7 days of hydraulic retention time ...decrease storage while meeting fire protection requirements
Significant Disinfectant Changes

• You must consult with EPA before making a significant change to your disinfection practices.

• Consultation must include:
  - a copy of your 1-year disinfection profile/benchmark,
  - a description of the proposed change,
  - an analysis of how the proposed change will affect current levels of disinfection.
Types of Significant Disinfection Changes For Reducing DBPs

- Changing type of disinfectant (e.g. switch from chlorine to chloramines or install UV in front of chlorination)
- Significantly decreasing the dosage of current disinfectant.
- Changing the point(s) of disinfectant application
Examples of Things to Consider in Making a Significant Change to Disinfection Practices

• To prechlorinate (before filters) to control biological growth in wet wells, or in filters….or

• To oxidize/precipitate out metals - would added oxidants address these problems but create DBPs compliance problem?
Examples of Things to Consider in Making a Significant Change to Disinfection Practices

• To switch disinfectants from chlorine to chloramines – adding ammonia, will increase nutrients for nitrifying bacteria in distribution system. Also, changes to chloramines will change water quality which may increase leaching of lead or copper from pipes, pinhole leaks in brass, accelerate deterioration of rubber materials, etc. You need to evaluate the chemistry of these disinfectants before deciding to make the switch.
Examples of Things to Consider in Making a Significant Change to Disinfection Practices

• If you change your type of filter aid/chemical pretreatment, or change the order in which the chemicals are added to improve TOC removal, this can affect other processes

• For example, adding lime for alkalinity/pH adjustment at the same location as your iron or aluminum based coagulants can hurt turbidity removal since the coagulant reacts with the lime.
Examples of Things to Consider in Making a Significant Change to Disinfection Practices

• Evaluate how treatment changes can affect:
  -- Turbidity of finished water
  -- Lead and Copper in pipes
  -- Total Coliform Compliance
  -- CT Inactivation rates (from pH changes, etc.)
Examples of Things to Consider in Making a Significant Change to Disinfection Practices

• Are you greatly overdosing your chlorine – look at disinfection profile for logs of inactivation. Rerun the profile with the lower dosage of chlorine you are proposing, and check if you still meet SWTR inactivation requirements (compare to benchmark).

• Is your chlorine dose erratic? Large surges in chlorine may increase DBP formation.

• REMEMBER – consult with EPA before making these significant changes.
For more Information

• Safe Drinking Water Hotline
  1-800-426-4791

• EPA R8 Drinking Water Websites –
  - Drinking Water Online website at
    [www.epa.gov/region8/waterops](http://www.epa.gov/region8/waterops)
  - Drinking Water Watch (DWW) password secured website at:
    [iaspub.epa.gov/Region8DWW/JSP/loginForm.jsp](http://iaspub.epa.gov/Region8DWW/JSP/loginForm.jsp)