Microbial Toolbox

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Outline

• Basis for required treatment
• Overview of toolbox tools
• Current information on existing toolbox tools
Basis for Required Treatment

• The 1996 SDWA Amendments required EPA to address risk from Cryptosporidium.
• Source water monitoring identified systems that are more vulnerable to Cryptosporidium contamination. Systems may be required to provide additional treatment.
• Amount of additional treatment depends on the level of Cryptosporidium detected
  – Below 0.075 oocysts/liter no additional treatment (Bin 1)
  – 0.075 to < 1.0 oocysts/liter need 1.0 - 1.5 log additional treatment (Bin 2)
  – 1.0 to < 3.0 oocysts/liter need 2.0 – 2.5 log additional treatment (Bin 3)
  – 3.0 or more oocysts/liter need 2.5 – 3.0 log additional treatment (Bin 4)
Overview of Toolbox Tools

• Source Toolbox Components
  – Watershed Control Program
    • 0.5 log credit for filtered sources
    • Unfiltered systems not eligible for credit
  – Alternative Source/Intake Management
    • No prescribed credit
    • Simultaneous monitoring for treatment bin classification

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Overview of Toolbox Tools (continued)

• Pre-Filtration Toolbox Components
  – Pre-sedimentation basin with coagulation
    • 0.5 log-credit for systems achieving 0.5 log turbidity reduction or state approved criteria
    • Basins must be operated continuously with coagulant addition and all plant flow must pass through the basin
  – Two-Stage Lime Softening
    • 0.5-log credit for two-stage softening where chemical additional and hardness precipitation occur in both stages.
    • All plant flow must pass through both stages
  – Bank Filtration
    • 0.5-log credit for 25-foot setback; 1.0-log credit for 50-foot setback
    • Aquifer must be unconsolidated sand containing at least 10 percent fines; average turbidity in wells must be less than 1 NTU
    • Systems using wells followed by filtration when conducting source water monitoring must sample the well to determine bin classification and are not eligible for additional credit
Overview of Toolbox Tools (continued)

• Treatment Performance Toolbox Components
  – Combined Filter Performance
    • 0.5-log credit for combined filter effluent turbidity ≤ 0.15 NTU in at least 95 % of measurements each month
  – Individual Filter Performance
    • 0.5-log credit (in addition to 0.5-log combined filter performance credit) if individual filter effluent turbidity ≤ 0.15 NTU in at least 95 % of samples each month in each filter and is never > 0.3 NTU in two consecutive measurements in any filter
  – Demonstration of Performance
    • Credit awarded to unit process or treatment train based on a demonstration to the state with a state-approved protocol
Overview of Toolbox Tools (continued)

- Additional Filtration Toolbox Options
  - Bag or Cartridge Filters (Individual)
    - Up to 2-log credit based on the removal efficiency demonstrated during challenge testing with a 1.0-log factor of safety
  - Bag or Cartridge Filters (In Series)
    - Up to 2.5-log credit based on the removal efficiency demonstrated during challenge testing with a 0.5-log factor of safety
  - Membrane Filtration
    - Log credit equivalent to removal efficiency demonstrated in challenge test for device if supported by direct integrity testing
  - Second Stage Filtration
    - 0.5-log credit for second separate granular media filtration stage if treatment train includes coagulation prior to first filter
  - Slow Sand Filters
    - 2.5-log credit as a secondary filtration step; 3.0-log credit as a primary filtration process; No prior chlorination for either option
Overview of Toolbox Tools (continued)

• Inactivation Toolbox Components
  – Chlorine Dioxide
    • Log credit based on measured CT in relation to CT table
  – Ozone
    • Log credit based on measured CT in relation to CT table
  – UV
    • Log credit based on validated UV dose in relation to UV dose table
    • Reactor validation testing required to establish UV dose and associated operating conditions
## Summary of Toolbox Technology Usage

<table>
<thead>
<tr>
<th>Toolbox Options</th>
<th>Percentage of systems using the tool*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watershed Control Program</td>
<td>10.4%</td>
</tr>
<tr>
<td>Alternative Intake/Source Management</td>
<td>3.1%</td>
</tr>
<tr>
<td>Pre-sedimentation basin with coagulation</td>
<td>2.1%</td>
</tr>
<tr>
<td>Two-Stage Lime Softening</td>
<td>No information available</td>
</tr>
<tr>
<td>River Bank Filtration</td>
<td>3.1%</td>
</tr>
<tr>
<td>Combined Filter Performance/Individual Filter</td>
<td>37.5%/34.4%</td>
</tr>
<tr>
<td>Filter Optimization (?)</td>
<td>3.1%</td>
</tr>
<tr>
<td>Demonstration of Performance</td>
<td>3.1%</td>
</tr>
<tr>
<td>Bag or Cartridge Filters (Individual or In series)</td>
<td>1.0%</td>
</tr>
<tr>
<td>Membrane Filtration</td>
<td>15.6%</td>
</tr>
<tr>
<td>Second Stage Filtration</td>
<td>1.0%</td>
</tr>
<tr>
<td>Slow Sand Filters</td>
<td>No information available</td>
</tr>
<tr>
<td>Chlorine Dioxide</td>
<td>1.0%</td>
</tr>
<tr>
<td>Ozone</td>
<td>2.1%</td>
</tr>
<tr>
<td>UV</td>
<td>19.8%</td>
</tr>
</tbody>
</table>

*Percentage of 96 PWSs using specific tools based on information obtained from the EPA Regions and States. Some PWS reports indicate they plan to use a particular tool or that they use a tool but not it’s unclear whether they claim credit for LT2 compliance purposes.
Current Information on Existing Toolbox Tools

- UV disinfection
  - New options for reactor validation
    - Some potential new challenge microorganisms have been identified (e.g., *Bacillus pumilus*)
    - Some studies have demonstrated that Computational Fluid Dynamics modeling can be effective for reactor validation
  - Medium pressure UV
    - Several studies have demonstrated lower UV doses required for virus inactivation with medium pressure UV than low pressure UV
    - Low wavelengths issues currently under investigation
Current Information on Existing Toolbox Tools (continued)

- River Bank Filtration (RBF)
  - A household intervention epidemiology study of consumers (55+ years old) found that AGI risks still exist in water undergoing RBF and meeting all Federal, state and local standards
  - A study is exploring if it’s scientifically feasible to demonstrate *Cryptosporidium* removal performance credit greater than 2-3 log
Current Information on Existing Toolbox Tools (continued)

• Other toolbox tools with information to be evaluated
  – Intake Management – research on models used to determine best location and depth of intakes
  – Membrane Filtration – removals achieved are dependent on type of membrane, test organism, water quality and operational conditions. Applicability to ceramic membranes being investigated.
  – Slow Sand Filters – Pilot- and full-scale studies identified key design and operational parameters
  – Chlorine Dioxide – Cryptosporidium inactivation dependent on pH, temperature and microbial lineage
  – Ozone – at least one study has shown ozone to be an effective disinfectant for inactivation of Cryptosporidium
Summary

- Information from 96 PWSs indicate that the most commonly used toolbox tools are: combined filter performance and individual filter performance, UV and membrane filtration.
- Recent information on tool effectiveness is available or under development for UV and river bank filtration.
- EPA is compiling information on effectiveness and implementation of ozone, alternative source/intake management, membrane filtration, slow sand filters and chlorine dioxide.
If you have any data and other information that would inform the review of the LT2 rule please send it to:

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