Drinking Water Compliance, Design & Operation of Storage Tanks

AQUA

We’re Laying the Groundwork for a Better Tomorrow.
Southeast Pennsylvania System

System Metrics
- 4,400 miles of pipe
- 8 surface WTP
- 97 Tanks
- 109 Wells
- 319 regulator valves
- 113 pressure zones
• **Storage Tanks are Engineering Issues:**
  - Support Domestic Consumption Activity
  - Fire Flow Deliverability
  - Emergency Supply
  - Smooth's Pressure Fluctuations
  - Supplements Baseline Plant and Well Sendout
  - Aesthetically Pleasing!
SE PA SYSTEM TANK TYPES
Compliance Viewpoint: Storage Tanks are BAD!!

• Storage Tanks are Compliance Issues
  – Drinking Water Outbreaks (Alamosa, CO; Gideon, MO)
  – Sanitary Defects
  – High water age
  – Sediment build up
  – High water temperatures
  – Low disinfectant residuals
  – Security risks
  – Can be dangerous to inspect
Alamosa, CO Outbreak

- March 2008 waterborne Salmonella outbreak
- 442 reported illnesses, 122 laboratory confirmed; one fatality. State estimates 1,300 people may have been ill.
- The suspect ground level storage reservoir had 12-18” of sediment. Fecal matter could have entered through cracks in the roof, sides. Small animals could have entered through holes.
- 1984 – last reported draining and cleaning
- 1997 – professional inspection. Noted exterior cracking
- System had plans to de-commission the reservoir
- No secondary disinfection residual required.
- Total outbreak costs estimated by CDC at approximately $2.6 million, but not all costs considered. CO believes costs were much higher.
Gideon, MO Outbreak

• December 1993 *Salmonella typhimurium* outbreak
• Over 600 people affected by diarrhea, 31 cases laboratory-confirmed; seven deaths of nursing home residents
• A municipal storage tank “provided an excellent roosting place for pigeons”. The tank was covered with dirt, pigeon droppings and feathers. Tank vents were improperly designed, allowed for the possibility of contamination
• Contaminated sediment in the tank was likely pulled into the distribution system by a vigorous flushing program that started near the tank.
Sanitary Defects

- Data from the Oregon Health Authority

<table>
<thead>
<tr>
<th>Tank Deficiencies</th>
<th>Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hatch not locked or adequately secured</td>
<td>111</td>
<td>5%</td>
</tr>
<tr>
<td>Roof &amp; access hatch not watertight</td>
<td>67</td>
<td>3%</td>
</tr>
<tr>
<td>No flap valve, screen, or equivalent on drain</td>
<td>119</td>
<td>5%</td>
</tr>
<tr>
<td>No screened vent</td>
<td>93</td>
<td>4%</td>
</tr>
<tr>
<td>Total Sanitary Surveys (includes PWSs w/o reservoirs)</td>
<td>2,268</td>
<td></td>
</tr>
</tbody>
</table>
Storage Tank Breaches

Large hole in vent screen. Screen is not fine enough. Band is not holding the screen in place.

07/22/2009
Storage Tank Contamination

Feathers and feces
Storage Tank Sediment
Storage Tank Sediment

Dead bird found after removing sediment
Security Concerns
Safety Concerns
Oh, and they can be quite ugly too!
How big an issue?

- EPA estimates > 100,000 facilities nationwide (excluding clearwells)
- Based on Association of State Drinking Water Administrators (ASDWA) survey:

<table>
<thead>
<tr>
<th>STATE</th>
<th>TOTAL</th>
<th>Elevated</th>
<th>Ground</th>
<th>Hydro</th>
<th>Under ground</th>
<th>Stand Pipe</th>
<th>Bladder</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA</td>
<td>9,893</td>
<td>582</td>
<td>2,514</td>
<td>3,911</td>
<td>1,508</td>
<td></td>
<td></td>
<td>1,378</td>
</tr>
<tr>
<td>FL</td>
<td>8,600</td>
<td>510</td>
<td>1,800</td>
<td>3,510</td>
<td></td>
<td></td>
<td>1,290</td>
<td>1,490</td>
</tr>
<tr>
<td>MO</td>
<td>4,742</td>
<td>1,183</td>
<td>923</td>
<td>827</td>
<td>196</td>
<td></td>
<td></td>
<td>1,051</td>
</tr>
<tr>
<td>NH</td>
<td>1,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,051</td>
<td>562</td>
</tr>
<tr>
<td>MT</td>
<td>898</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
So what do we do about these tanks?

- For one, **INSPECT** them regularly!
  - In fact, federal rules mandating inspections/cleanings are coming
  - The Total Coliform Rule/Distribution System Federal Advisory Committee (FACA) recommended additional research/information collection on storage tanks and 6 other distribution system issues
  - EPA held a public meeting and Webinar on October 15, 2014 on Distribution System Storage Facility Inspection & Cleaning
  - “EPA, state and industry guidance have long recommended cleaning and inspection every 3 to 5 years, however contamination and infrequent inspection and cleaning still occur in some facilities”
  - EPA to propose a Finished Water Storage Facility Inspection Rule in January, 2018
• Routine Tank Inspections
  – Visual (ground level) storage tank inspection to identify sanitary defects that cover exterior conditions, as well as security and safety concerns.

• Periodic Tank Inspections
  – Storage tank inspection of areas not visible from the ground to identify sanitary defects that cover exterior conditions, as well as security and safety concerns. AWWA is not recommending a minimum frequency, but suggesting federal guidance at annual.

• Comprehensive Tank Inspections
  – Storage tank inspection to identify sanitary defects that cover the external and internal conditions of the tank, as well as security and safety concerns. AWWA is not recommending a minimum frequency, but suggesting federal guidance at every five years.
## RTCR Technology and Cost Document – Exhibit 5-25
Estimated Costs for the Inspection and Cleaning of Storage Tanks (2007$)

<table>
<thead>
<tr>
<th>System Size</th>
<th>Tank Size (gal)</th>
<th>Tank Type</th>
<th>Total Cost¹ (2007$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100</td>
<td>25,000</td>
<td>Elevated</td>
<td>$1,340</td>
</tr>
<tr>
<td>101 - 500</td>
<td>50,000</td>
<td>Elevated</td>
<td>$1,510</td>
</tr>
<tr>
<td>501 - 1,000</td>
<td>100,000</td>
<td>Elevated</td>
<td>$1,830</td>
</tr>
<tr>
<td>1,001 - 4,100</td>
<td>250,000</td>
<td>Elevated</td>
<td>$3,190</td>
</tr>
<tr>
<td>4,101 – 33,000</td>
<td>500,000</td>
<td>Elevated</td>
<td>$5,020</td>
</tr>
<tr>
<td>33,001 - 96,000</td>
<td>1,000,000</td>
<td>Elevated</td>
<td>$7,750</td>
</tr>
<tr>
<td>96,001 - 500,000</td>
<td>1,000,000</td>
<td>Elevated</td>
<td>$7,750</td>
</tr>
<tr>
<td>500,001 - 1,000,000</td>
<td>2,000,000</td>
<td>Elevated</td>
<td>$9,110</td>
</tr>
<tr>
<td>&gt; 1,000,001</td>
<td>2,000,000</td>
<td>Elevated</td>
<td>$9,110</td>
</tr>
</tbody>
</table>

¹ Cost includes inspection, labor, equipment, and insurance.
State advice to EPA on crafting a rule/guidance/policy

• Appropriate actions are very system specific, so avoid a “one size fits all” rule. Give states flexibility to tailor the requirements to local conditions.

• EPA should provide some guidance on criteria for the conduct of inspections/cleanings and qualifications for persons performing the work.

• EPA actions could cover other tank issues beyond inspections and cleaning:
  – Tank O&M
  – Water age
  – Mixing
  – Security
What else do we do with these tanks to address potential water quality issues?

• Well, at Aqua where we own 97 of these tanks in Southeast PA alone,

• Trying to wrap our arms around the issue is rather daunting

• So, we decided to take a “holistic” assessment of our tanks and prioritize them for further review. Our assessment included:
  – Whether the tank influences other tanks in the system
  – Mixing characteristics
  – Turnover
  – Water Age
  – Historical disinfectant residual measurements
  – Indications of potential nitrification
### Tank Prioritization Scoring Guideline:

<table>
<thead>
<tr>
<th>Weight</th>
<th>Category</th>
<th>Score of 2 if:</th>
<th>Score of 1 if:</th>
<th>Score of 0 if:</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td>Impacts WQ in other tanks</td>
<td>Tier 1 Tank: receives water directly from EP or IC and sends water to other tanks</td>
<td>Tier 2 Tank: receives water from a Tier 1 tank &amp; sends water to other tanks</td>
<td>Tanks that don’t send water to other tanks</td>
</tr>
<tr>
<td>10%</td>
<td>Poor tank mixing</td>
<td>Gravity common fill/draw into tank with no riser</td>
<td>Other</td>
<td>Solar Bee, Grid Bee, Tideflex</td>
</tr>
<tr>
<td>10%</td>
<td>Turnover/Water movement</td>
<td>Turnover &lt; 10%</td>
<td>Turnover between 10% and 30%</td>
<td>Turnover &gt; 30%</td>
</tr>
<tr>
<td>15%</td>
<td>Modeled Water Age</td>
<td>Water Age &gt; 7 days</td>
<td>Water Age between 2 and 7 days</td>
<td>Water Age &lt; 2 days</td>
</tr>
<tr>
<td>20%</td>
<td>Disinfectant Residual</td>
<td>% of time TCl &lt; 0.5 mg/l &gt; 66%</td>
<td>% of time TCl &lt; 0.5 mg/l is between 33% and 66%</td>
<td>% of time TCl &lt; 0.5 mg/l &lt; 33%</td>
</tr>
<tr>
<td>20%</td>
<td>Nitrite detection between May &amp; Nov.</td>
<td>Yes</td>
<td>NA</td>
<td>No</td>
</tr>
</tbody>
</table>
Results of Tank Prioritization Scoring

- Out of the tanks assessed in the Main Division:
  - 7 tanks listed as Highest Priority (score greater than 1.4)
  - 13 tanks listed as Medium Priority (score between 1.0 and 1.4)
  - Rest listed as low priority (score less than 1.0)
Passive Mixing System
Passive Mixing
Solar Bee
Tank Shark Pilot
Scenario 3 Model Results
Streamlines of Velocity (Low Water, 700 gpm, 0 to 0.1 fps)

ISO View

Side View

Front View

CFD Modeling
CYNWYD TANK
SEPA Tank Water Quality Action Master List:

**Plants**
- Shifting CL2 dosing points
- Optimize Cl2 to ammonia ratio to 5:1
- Raise disinfectant residual dose from 2 to 3 mgl
- Raise Ph level

**Tanks**
- **TANK RE-PAINTING**
  - Clarify/re-pipe/label sampling points
  - Add additional sample boxes
  - Add new inlet/outlet configuration
  - Add SolarBee, GridBees, Tideflex where necessary
  - Add "Monitor" pump to manage water quality
  - Add new PRV controls to manage water quality
  - Add yard valves to manage water quality

**CHANGING OPERATIONS**
- Lower the operating range in whole / part
- Increase daily tank deflection
- Routine ""deep"" cycling
- Create "gap" between fill and draw cycles
- Revise chlorine dosage operations
- Add ammonia dosing
- Correct defective check valves
- Add check valves to reduce age
- Bring tank "fill" water from new source
- Pilot Tank Shark product
- "Early warning" limits on LIMS
- Add time clock controls on SCADA
- Take LaMott Tank OOS
- Reduce importation at Cheltenham
Summary

• Distribution System Engineers and Compliance Managers can agree that finished water storage tanks are vital to our mission of providing safe, reliable drinking water 24/7, including emergencies such as fires.

• However, they need to be “managed”. That means inspections, cleanings, regular monitoring, and where needed improvements such as additional mixing to ensure water quality goals are constantly met.

• Expect more requirements for finished storage tanks to come from EPA in the not too distant future and stricter requirements for minimum disinfectant residuals from PADEP even sooner.

• If you have finished water storage tanks, and you do not have a regular tank management program including monitoring, inspections, and cleaning when necessary, its time to start!
Questions?
TANKS!

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• 7.A.1
  • Storage facilities should have adequate capacity to meet domestic demands, and where fire protection is provided, fire flow demands.

• 7.A.1.b
  • The minimum storage capacity (or equivalent capacity) for systems not providing fire flow protection shall be equal to 1 day average consumption.
Bala Cynwyd Standpipe