



MDE requirements for Tank Mixing Systems in new Drinking Water Storage Tanks

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MDE's Role in Public Health

- **WSP Mission:** The mission of the Water Supply Program is to ensure that public drinking water systems provide safe and adequate water to all present and future users in Maryland, and that appropriate usage, planning and conservation policies are implemented for Maryland's water resources.
- **Capital Projects:** MDE must approve major capital projects for public water supplies.

Water Construction Permit

- Environment Article, Title 9; COMAR 26.03.12
- Water and sewerage construction permits are required before **installing, extending or modifying ... Major Water Facilities:** (including)
 - _ Water mains (diameter >15")
 - _ Pumping or booster station
 - _ **Elevated tank or storage tank**
 - _ Water treatment facilities
 - _ Utilization of well water for public water supply

Secretarial Authority To Protect Public Health

Md. ENVIRONMENT Code Ann. § 9-221 :

...the Department may order the owner:

(1) To alter or extend the water supply system, sewerage system, or refuse disposal system; or

(2) To install a new water supply system, ...

WSP Construction Permit Review

- The Water Supply Program reviews Drinking Water System Project designs as part of the Water Construction Permit Process
- Our review checks compliance with applicable standards and regulations, determines whether the design will achieve a necessary improvement or fix a problem, and seeks to ensure the project will not create operational or compliance problems.
- Public Health is our overriding concern.
- The construction permit is issued by the Engineering and Capital Projects Program.

MDE Design Standards

- MDE utilizes the “10 States Standards” as our design standards for Public Water Supply projects



10 States Standards: Tank Mixing

7.0.6 Stored Water Turnover

The system should be designed to facilitate turnover of water in the reservoir. Consideration should be given to separate inlet and outlet pipes, baffle walls or other acceptable means to avoid stagnation.

Tank Water Quality Concerns

- Improper materials and coatings
- Design flaws which could allow contaminants to enter
- Security
- Water quality deterioration

WSP Experience

- MDE's WSP regulates more than 1,000 public water systems in Maryland.
- We receive reporting of daily bacteria and chlorine residuals in large Community Water Systems.
- The Engineering and Technical Assistance Division (ETAD) responds to MCL violations, emergencies, customer complaints, conducts sanitary surveys, and reviews capital improvement designs.
- Water Quality issues are the most common complaint.
- ETAD participates in an EPA Region 3 Area Wide Optimization work group that has studied chlorine residual fluctuations in elevated storage tanks.

Water Age Issues

- Taste and odor
- Disinfectant decay
- Disinfection by-product formation
- Stratification
- Nitrification and Microbial re-growth
- Increased sediment deposition

Loss of Chlorine Residual

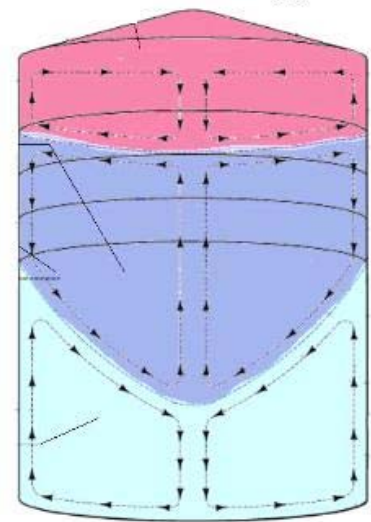
- Can contribute to microbiological problems such as growth of organisms within the bulk water or sediment.
- A long detention time can allow the disinfectant residual to be completely depleted, thereby not protecting the finished water from additional microbial contaminants that may be present in the distribution system downstream of the storage facility.
- The rate of decay can be affected by external contamination, temperature, nitrification, exposure to sunlight, and amount and type of chlorine demanding compounds present such as organics and inorganics.

Disinfection By-product Formation

- Storage facilities provide opportunities for increased hydraulic residence times, allowing more time for disinfection by-products (DBPs) to form.
- Higher water temperatures in steel tanks during summer seasons can increase disinfection by-products as the chemical reactions proceed faster and go further at higher temperatures.
- Re-chlorination within storage facilities exposes the water to higher chlorine dosages, potentially increasing disinfection by-product formation.
- Storage facilities with new interior concrete surfaces often have elevated pH levels that can also increase trihalomethane formation.

Stratification

- Most common in Standpipes, can occur in other types of Storage Tanks.
- Results in differential water age and temperature in tank.
- Can allow water stagnation, microbial regrowth, and disinfectant decay.



Mixing and Turnover

- According to EPA's White Paper, *“When mixing does not occur throughout the storage facility, stagnant zones can form where water age will exceed the overall average water age in the facility.”*
- Reducing stagnant zones can reduce disinfectant residual loss (Kirmeyer).

Conclusion/Discussion

- Water quality is the most common complaint that the MDE Water Supply Program receives.
- Water quality can degrade in tanks.
- Water age is a key parameter.
- Mixing can improve water quality.
- MDE has a duty to protect public health and ensure public drinking water is aesthetically pleasing.

Sources

- ***EPA Water Age Distribution White Paper***
- ***Maintaining Water Quality in Finished Water Storage Facilities*** (Kirmeyer et al.,1999)
- ***Water Storage Tanks: Monitoring, Operation and Modifications Water Storage Tanks:*** (Pat McCool)
- ***The Science of Mixing Water Storage Tanks*** (Michael J. Duer, P.E., Red Valve Co., Inc.)
- ***Water Quality in Distribution Systems*** (Z. Michael Lahlou, Ph.D.)