Pennsylvania AWWA
American Water Works Association

Tank Rehabilitation and Retrofit Enhancements to Preserve Water Quality

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Overview

- Maintaining water quality and optimum performance of water storage tanks is a critical issue
- Tank-specific inspection and maintenance practices identify potential structural and performance concerns
- Retrofit and rehabilitation to existing infrastructure can ensure your water system is safe and reliable

Tank Inspections

- AWWA M42:
  - "*The maximum intervals for periodic inspection of the tank interior should normally be 3 years. It is usually advisable to wash out the tank at the time of inspection." pg. 67*
  - *"…proper inspections cannot be conducted if sediment covers the bottom of the tank. The tanks should be washed out and inspected at least every 3 years, and where water supplies have sediment problems, annual washouts are recommended." pg. 88*

Tank Inspections

- Routine-daily/weekly
  - Identify potential issues before they become major problems
- Periodic-monthly/quarterly
  - Visual inspection of tank interior (limited) and exterior
  - Detection of recurring water quality problems causes
- Comprehensive-3-5 years
  - Complete inspection and evaluation of tank interior and exterior condition

Routine Inspection

- Self Inspection Checklists
  - Screens intact and tight
    - All vents and overflows
  - Cracks or corrosion in tank structure
  - Coating Failure
  - Wet or Damp areas
  - Ladders and safety climbs
  - Hatch functionality
    - Lock and Hinges

Routine Inspection

- Exterior Concrete Cracking and Spalling

Routine Inspection

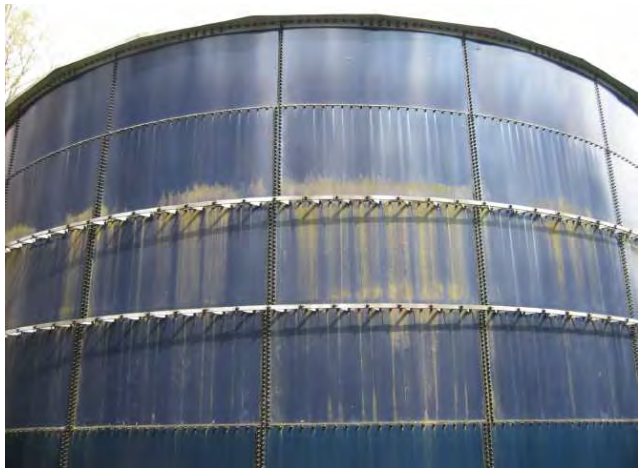
- Exterior Corrosion, Access, and Security

Periodic Inspection

- Visual inspection of tank interior (limited) and exterior
  - Detection of recurring water quality problems and causes
- Inspected Elements
  - Corrosion Areas
  - Concrete
  - Operating Systems
  - Coatings

Periodic Inspection

- Document acute changes



Periodic Inspection

- Exterior Paint, Coatings and Sealants

Periodic Inspection

- Interior Appurtenances

Comprehensive Inspection

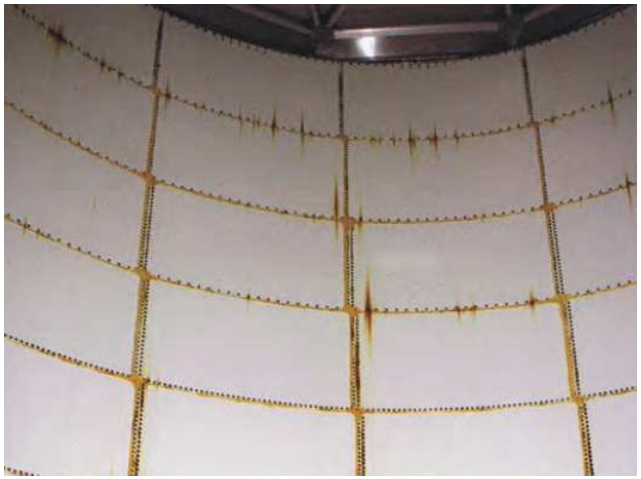
- Six categories of items to inspect:
  - Sanitary conditions
  - Structural conditions
  - Safety equipment conditions
  - Coating systems conditions
  - Security conditions
  - Mechanical conditions
  - General details

Comprehensive Inspection

- Interior tank deterioration

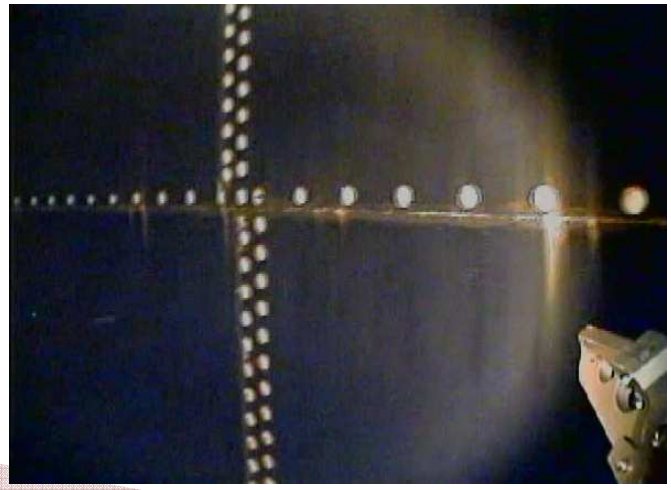
Comprehensive Inspection

- Interior tank deterioration



Comprehensive Inspection

- Cathodic Protection Systems



Rehabilitation and Retrofit Options

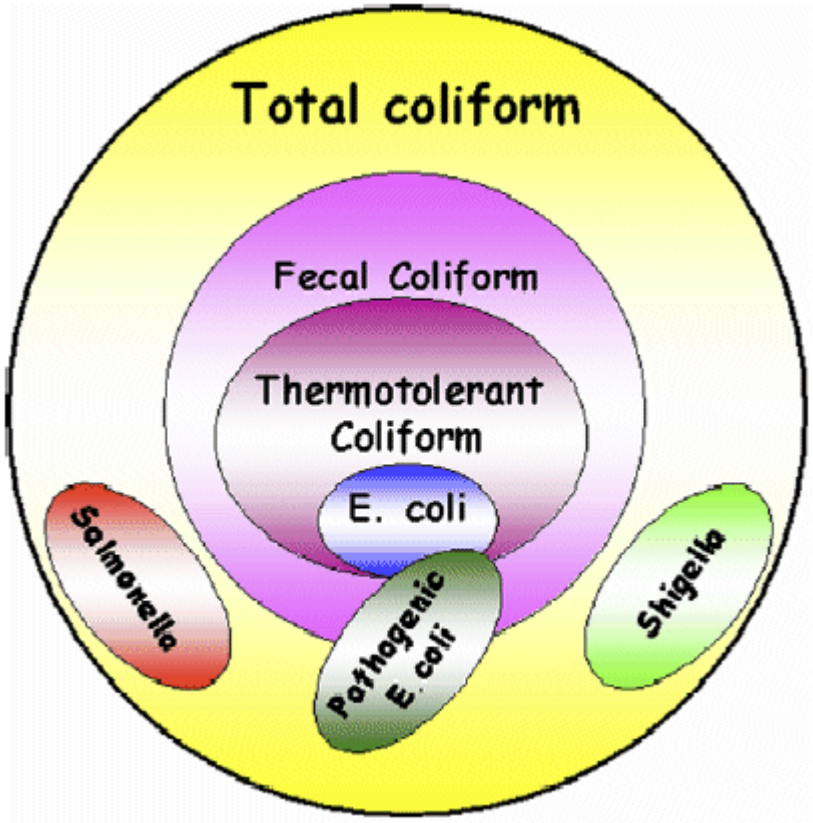
- Water Quality
  - Structural
  - Operational
  - Safety
  - Access
  - Security
  - Appurtenances

Importance of Water Quality

Vs.

Water Quality Issues

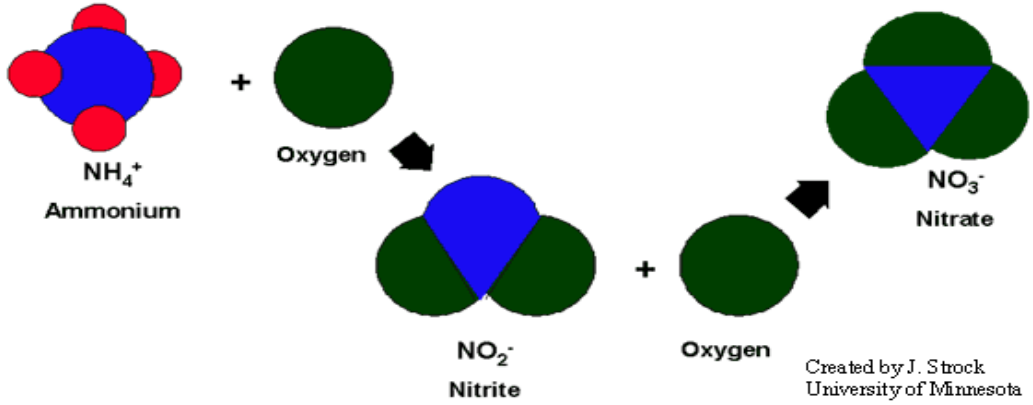
- Microbiological
  - Coliform bacteria
    - Indication of possible contamination
    - E. Coli & Salmonella prevention
  - Sources
    - Environmental
    - Vermin
    - Ground water infiltration



Water Quality Issues

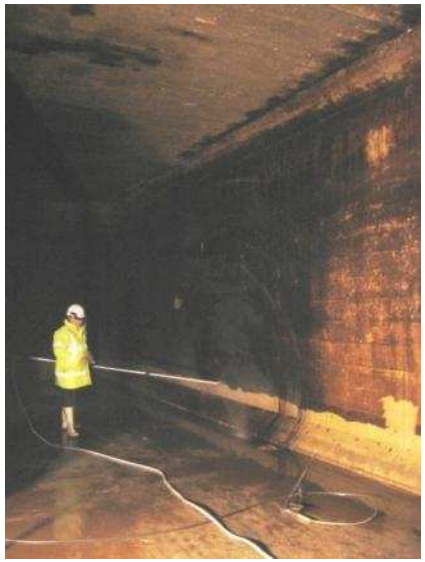
- Microbiological
  - Nitrification (Chloramine Disinfection)
    - 2 step process creating nitrite & nitrate
    - Nitrite & nitrate can have harmful affects
      - Blue Baby Syndrome

Nitrification



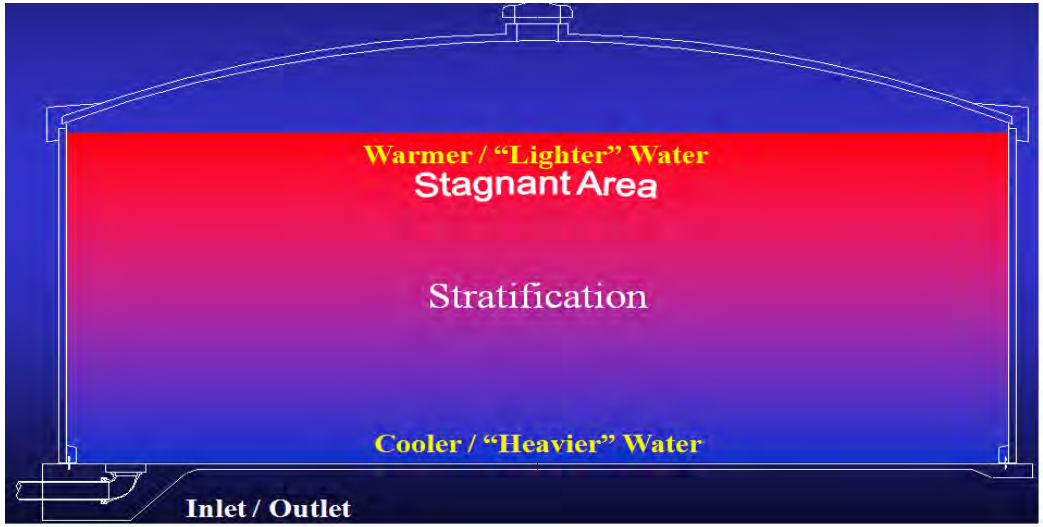
Water Quality Issues

- Physical
  - Sediment Buildup
    - Causes staining and discoloration
    - Water flow increase can stir up sediment, causing discoloration
    - Creates an environment for bacterial growth



Water Quality Issues

- Physical
  - Stratification
    - Thermocline
      - Creates layer of cooler “heavier water” and warmer “lighter water”
      - Inhibits mixing by creating barrier in water level

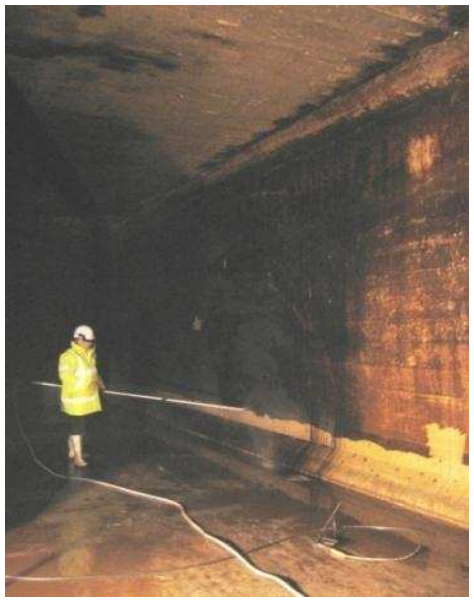


Water Quality Issues

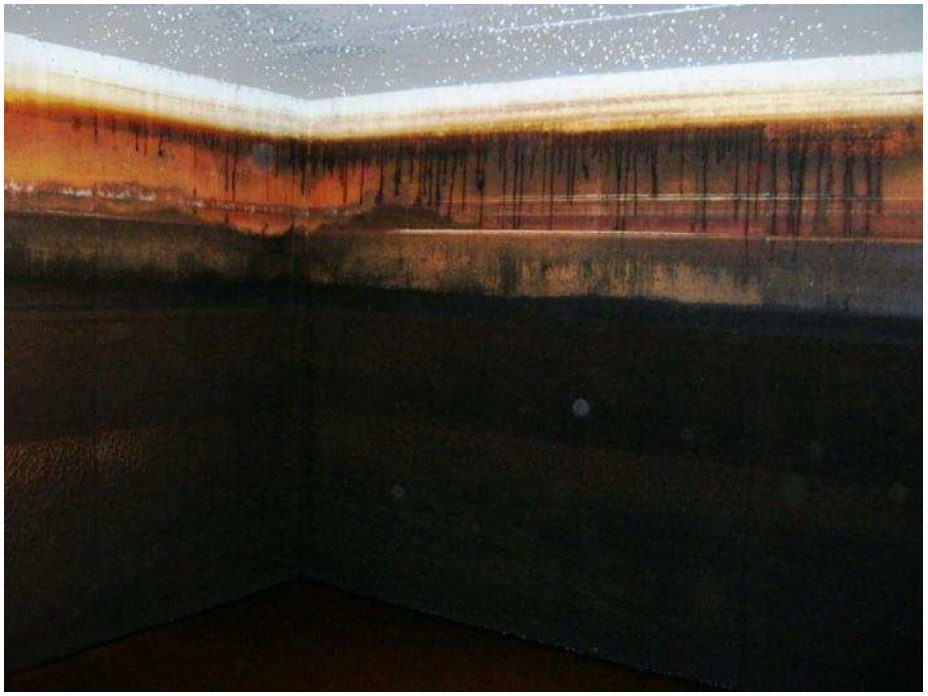
- Chemical
  - Disinfection by-products (DBP)
    - Reaction between disinfectant (typically chlorine) and organic matter in water creates certain acids.
    - These acids can reduce the pH in the water, causing the effectiveness of the chlorine to decrease.
  - Chlorine Residual Levels
    - High vs. Low
    - Taste & Odor

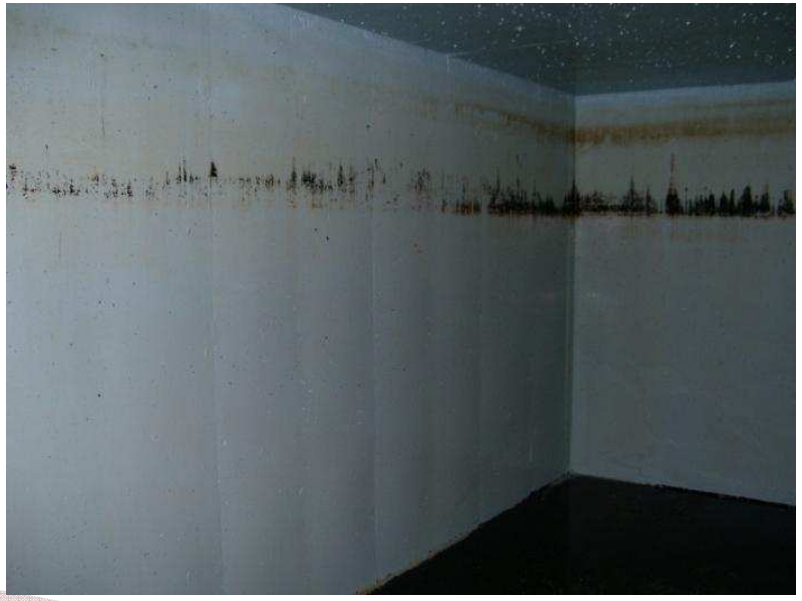
Tank Cleaning

- Chlorine Disinfection
  - Interior Chlorine Rinse
  - Routine testing and cleaning can prevent bacteria growth and potential health hazards
- Chemical Cleaning
  - Iron & Manganese Removal
    - Fe & Mg may be present in groundwater
  - Removes Biofouling
  - Chlorine Alternative – Less Harmful

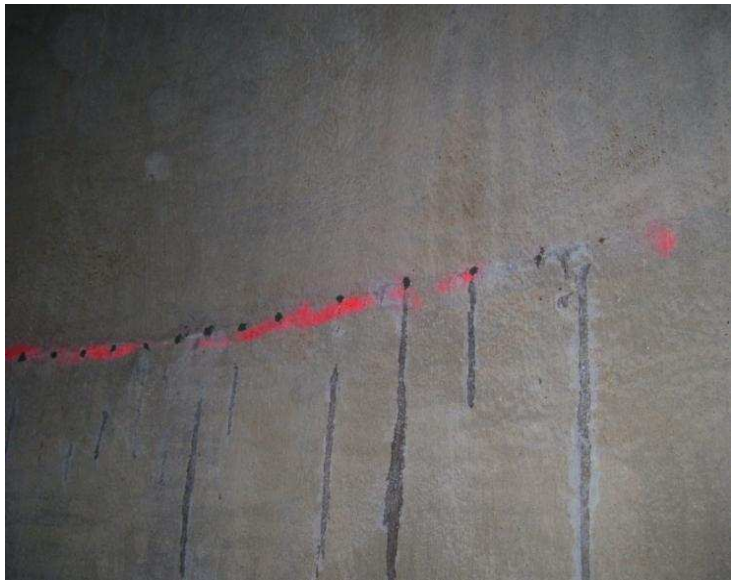


Heavy Iron & Manganese Buildup



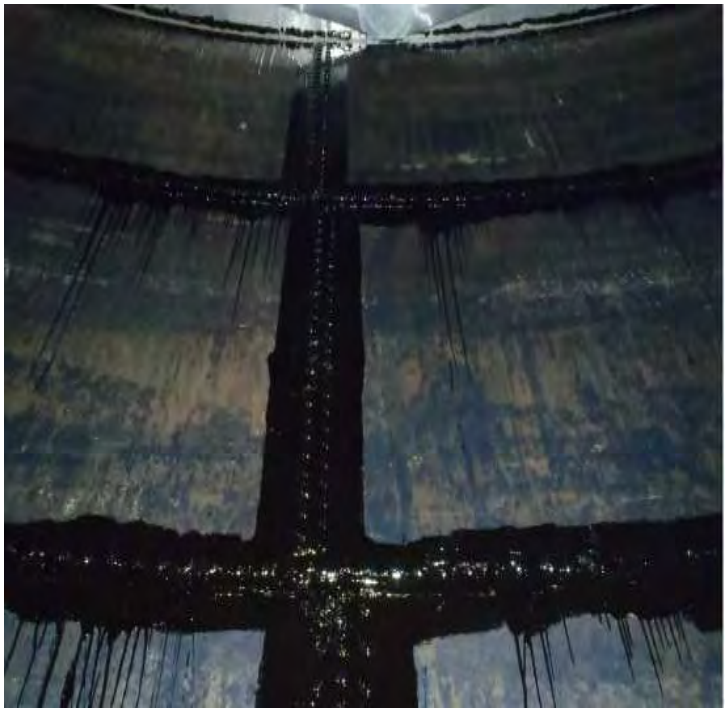


Rehabilitation – Cracking



Rehabilitation – Construction Joints

Rehabilitation – Coatings and Sealants



Water Quality and Storage Tank Concerns

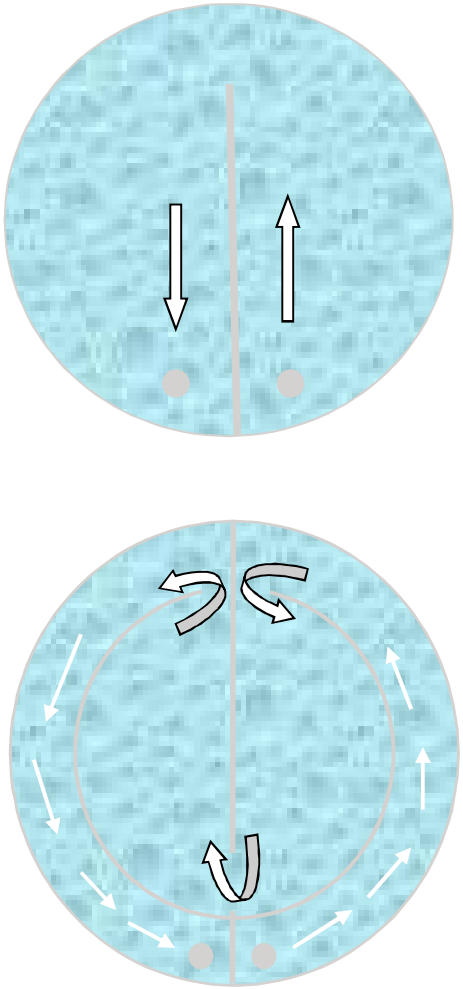
- Extended water age leads to:
  - Microbial growth
  - Chemical changes
  - Physical water quality deterioration
- Causes:
  - Lack of mixing
  - Inadequate turnover
  - Short-circuiting, inadequate pipe design

Solutions

Baffle Walls	• Fabric and/or Concrete
Mixing Systems	• Hydrodynamic vs Mechanical
Cleaning	• Chemical Application & Chlorine Disinfection

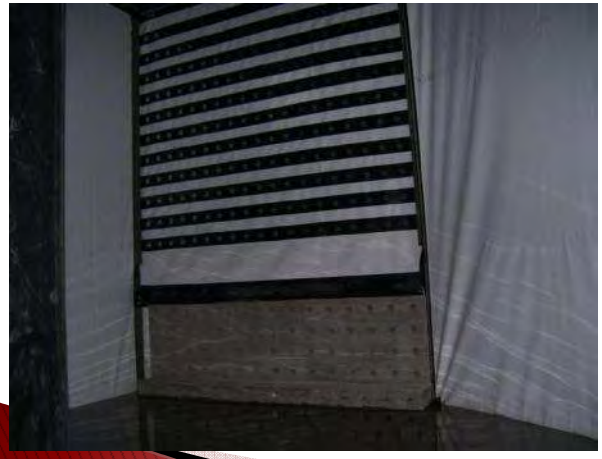
Baffle Walls

- Provides specific contact time (C_t) for water in tank
  - Increases the efficiency of the tank (Plug Flow)
  - Increases the path that the water travels from inlet to outlet
  - Minimizes contact between entering water and water already in tank

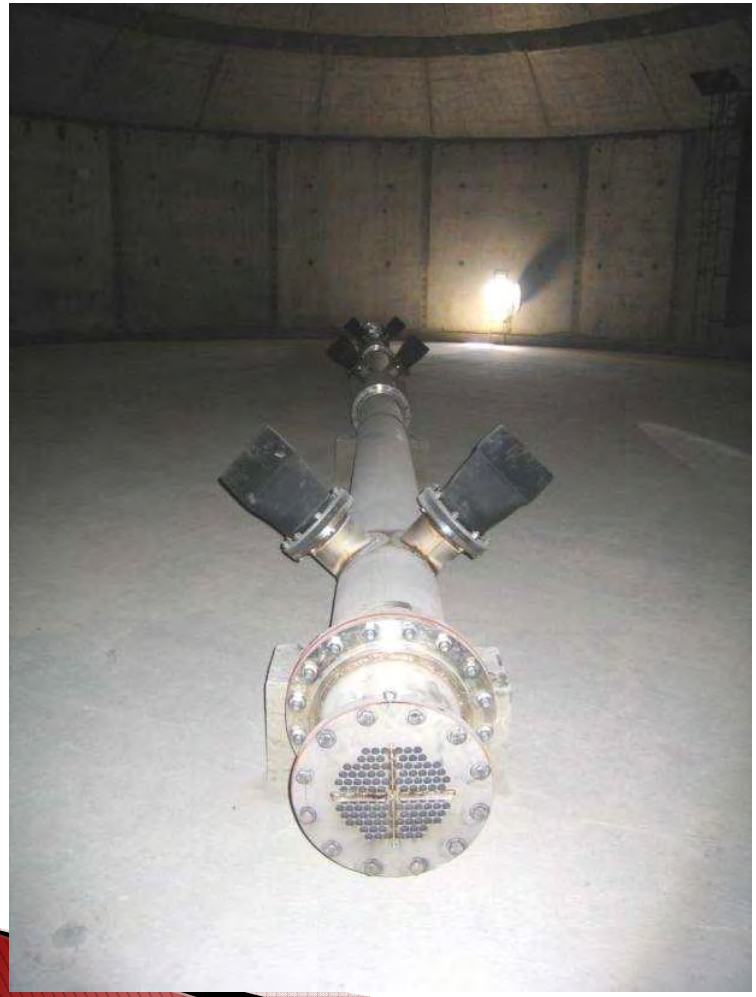


Concentric C Baffle – Diffuser Wall



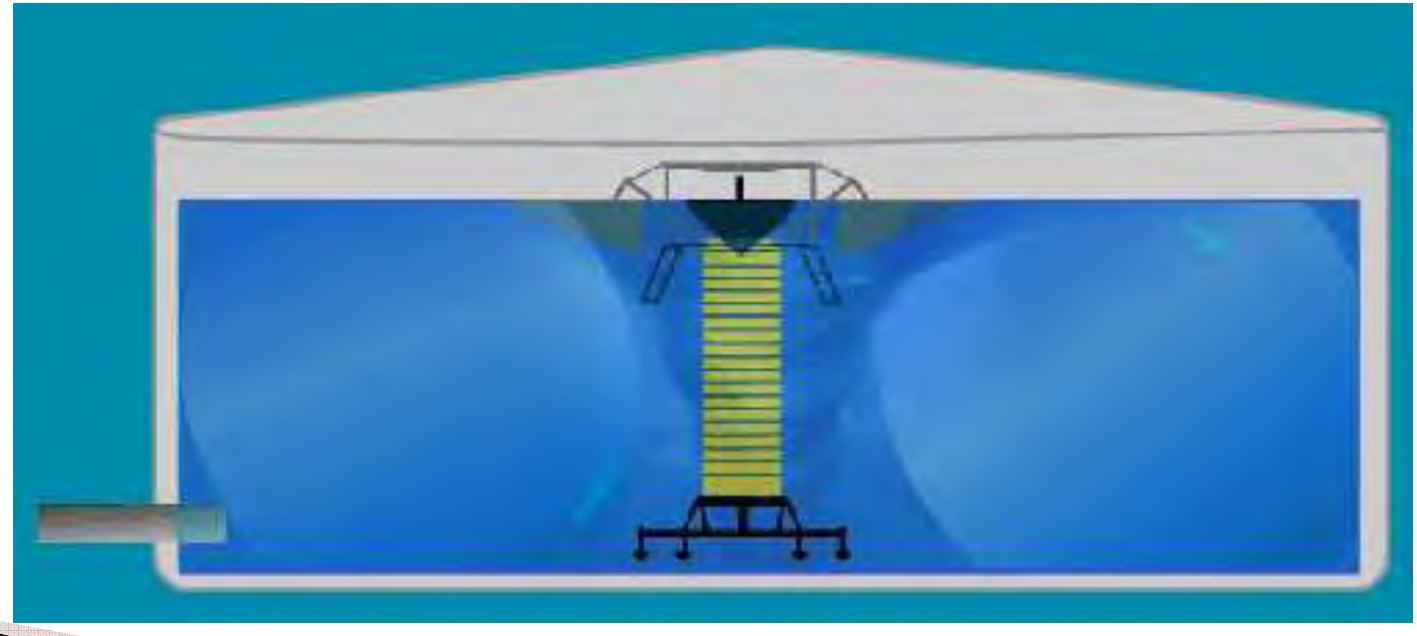
Hydrodynamic Mixing System Across Floor



Vertical Hydrodynamic Mixing System

Mechanical Mixing System

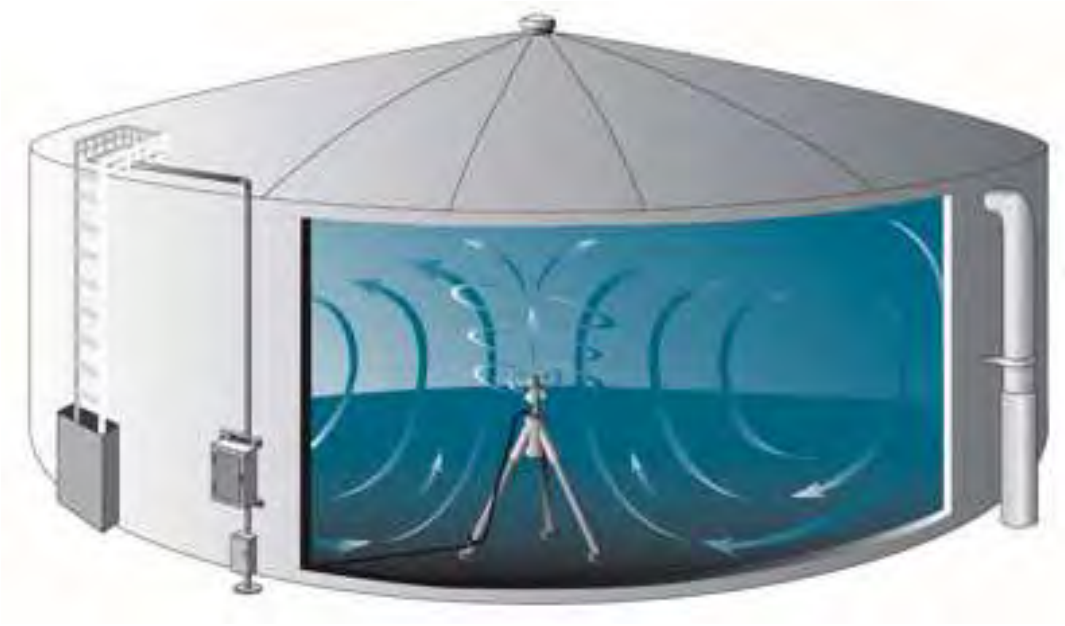
- Prevents stagnation, thermal stratification, nitrification and short circuiting.
- Provides complete mixing of influent and outflow.
- Can be solar powered.



Mechanical Mixing System

- Can require a small amount of power to operate
- Fast, cost efficient installation

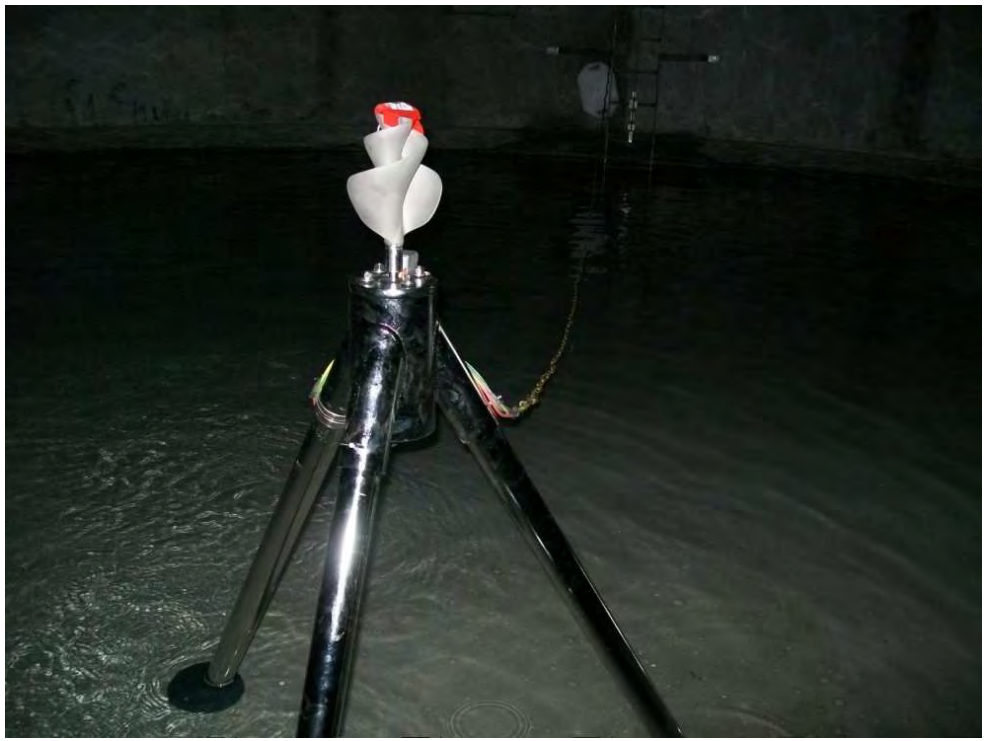
PAX Water Technologies



PAX Water Technologies

Mechanical Mixing System

- PAX installed in a water storage tank



PAX Water Technologies

Retrofit – Operational Piping Modifications

Retrofit – Operational Piping Modifications

Retrofit – Safety, Security, Access

QUESTIONS?