All Mixed Up?
Picking and Choosing
Your Tank Mixing System

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Tank Mixing

• Still in its infancy.
• Majority of tanks do not have mixers.
Overview

• What’s the Problem?
• Tank Design & Mixing
• Mixers
  • Types
  • FAQ
• Case Studies
• How to Pick?
What’s the Problem?

- Zones of older water
- Thermal stratification
- Chemical stratification
- Sediment buildup

Will Mixing Help?
Yes!
What’s the Problem?

- Loss of chlorine residuals
- Microbial growth & biofilm formation
- Formation of disinfectant byproducts
- Taste & odor complaints

Will Mixing Help?
Yes!
What’s the Problem?

- Coating abrasion
- Structural damage
  - Leaks - bolted
  - Ladders
  - Overflows
- Complete freezing, loss of storage

Will Mixing Help?
Yes!
What’s the Problem?

Got data?

Monitoring Studies

• **Water Quality** – Chlorine residual readings at various levels inside tank or system.
• Tracer Studies or Computational Fluid Dynamic **(CFD) Modeling** – Info on mixing behavior.
• **Temperature** – Temperatures at various levels inside tank over short and long term.
Tank Design

In the past...
- Hydraulic requirements
- Equalize pressure
- Balance water use during the day
- Emergency storage, fire protection
- More is better
- Bigger is better
- Future growth
Tank Design Geometry

EASY

HARD
Tank Design: *Back In The Day*
Tank Design: Options
Tank Design: *Options*
Tank Design: Standpipe
Tank Design: *Standpipe vs. Elevated*
Mixers What can they do?

- Move water in the tank
- Inject chemicals
- Prevent or minimize freezing
- Reduce water age
Mixers Types

**Passive**
Increase water velocity upon entering tank to mix.

**Active**
Provide energy to move water in the tank.

*Photos courtesy of Tideflex Technology and PAX Water Technology*
**Mixers Differences**

<table>
<thead>
<tr>
<th>Passive</th>
<th>Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>X Moving parts</td>
<td>✓ Moving parts</td>
</tr>
<tr>
<td>X Power</td>
<td>✓ Power</td>
</tr>
<tr>
<td>X Maintenance</td>
<td>✓ Maintenance</td>
</tr>
<tr>
<td>✓ Drain tank to install</td>
<td>X Drain tank to install</td>
</tr>
<tr>
<td>X Always mixing</td>
<td>✓ Always mixing</td>
</tr>
<tr>
<td>✗ Accurate data critical to design</td>
<td>✓ Accurate data critical to design</td>
</tr>
<tr>
<td>X Move to another tank</td>
<td>✓ Move to another tank</td>
</tr>
<tr>
<td>✓ Small pressure loss</td>
<td>X Small pressure loss</td>
</tr>
<tr>
<td>✓ Chemical injection</td>
<td>✓ Chemical injection</td>
</tr>
</tbody>
</table>
Mixers Passive

Photo courtesy of Tideflex Technology
Passive Homemade
Passive: Tideflex
Passive CB&I - FreshMix

Photo courtesy of CB&I
Passive Landmark Tanks
Hydrodynamic Mixing System (HMS)

Photo courtesy of Landmark Corporation
Passive “Tank Mixer” from York Water
Passive “Tank Mixer” from York Water
Passive “Tank Mixer” from York Water
Active PAX

Photo courtesy of PAX Water Technologies
Portable Water Quality Monitoring

Photo courtesy of Medora Corporation
Active GridBee

Photo courtesy of Medora Corporation
Photo courtesy of Medora Corporation
Active Tank Shark

Photo courtesy of UGSI Solutions, Inc.
Active PHI, Pulsair

Photo courtesy of Pulsed Hydraulics, Inc.
1. Do I need to drain and clean out my tank first?  
No, but it’s recommended.
2. Does the PA DEP require mixing in all tanks?  
No, but it should be considered.
3. Will the SolarBee work on a shady site?  
Not always.
4. Who installs mixers?  
Owners, Tank Painters, Tank Builders, Suppliers.
5. Which type should I buy?  
???????
Mixers 8 Case Studies

Photo courtesy of Medora Corporation
2.0 MG Reservoir

250,000 Gallon Spheroid
POTABLE WATER QUESTIONNAIRE

Please enter as much information as possible in the boxes below, then email this form to INFO@MEDORACO.COM, or fax to 701-225-0002.

A. TANK LOCATION AND OWNER INFORMATION

RESERVOIR OR TANK OWNER, and CITY and STATE
North Penn Water Authority, Lansdale, PA

RESERVOIR OR TANK NAME
Hilltown #1 and #2 Tanks

TANK STREET ADDRESS
Clearview Rd x E. Cherry Ln., Souderton, Pa

CLIMATE NOTE (HOT, DESERT, EXTREME COLD, OTHER)
Extreme cold occasionally

CONTACT NAME

ORGANIZATION

MAILING ADDRESS

EMAIL AND FAX

PHONE (OFFICE & CELL)

Accurate Data

TYPE OF DISINFECTANT BEING USED IN THIS WATER? (CHLORINE, OR CHLORAMINE, OR OTHER)

IS THE SOURCE WATER FROM SURFACE (RIVER AND IMPoundMENTS,) OR WELLS

EXISTING TANK, OR NEW TANK BEING CONSTRUCTED

THIS TANK'S MAIN FUNCTION, SUCH AS GENERAL STORAGE, CT TANK, CLEARWELL, OTHER

EXISTING AND/OR EXPECTED WATER QUALITY PROBLEMS IN THIS TANK

PROJECT OBJECTIVES: GENERAL MIXING, THM REMOVAL, CHLORINE BOOSTING, ICE PROTECTION

MOST STATES REQUIRE A PERMIT FOR MIXING OR THM REMOVAL IN A TANK, DOES YOURS

C. TANK DESCRIPTION AND DIMENSIONS (PLEASE FILL OUT THE PERTINENT SECTION BELOW)

PUT "X" IN ONE:

Spheroid
Hydropillar
Cylindrical
Other

RATED VOLUME, GALLONS

RISER DIAMETER, INCHES
Wet Riser or Dry Riser:

RISER HEIGHT, FEET

DISTANCE, TANK BOTTOM TO GROUND

HATCH: UNOBSCTURED L X W, INCHES
Entech Engineering was NOT the designer for this mixer.
Mixing Time and Minimum Required Drawdown

0.25MG Standpipe

Mixing Time
Fill Time Required to Achieve Complete Mixing during Fill
750,000 Gal.

250,000 Gal.

Pump: 350 gpm
Speed of water entering tank critical for complete mixing for a passive mixer.
- PSI provides equipment.
- Owner provided installation and electrical.
Mixer with Aeration THM Removal
Blower pushes air into tank.

Spray nozzles

Headspace:
Two feet minimum operating height; four feet during installation.

THMs enter the tank while it is filling.

Photo courtesy of Medora Corporation
THMs

• Entering Tank: 129
• Inside Tank: 65
• Exiting Tank: 46

Cut by almost 2/3
Aeration  THM Removal - Homemade

- Pump
- Piping up shell
- Roof couplings
- Spray nozzles

$17,000
Tornado Troubles
Tank demolition improves water quality
<table>
<thead>
<tr>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>What’s the problem?</td>
</tr>
<tr>
<td>Are your Operators hands-on?</td>
</tr>
<tr>
<td>Is your personnel trained to climb tanks?</td>
</tr>
<tr>
<td>Is initial cost the biggest factor?</td>
</tr>
<tr>
<td>Or cost plus O&amp;M over time?</td>
</tr>
<tr>
<td>Ease of use?</td>
</tr>
<tr>
<td>Reliability?</td>
</tr>
<tr>
<td>Familiarity?</td>
</tr>
<tr>
<td>Questions</td>
</tr>
<tr>
<td>------------------------------------</td>
</tr>
<tr>
<td>Is tank maintenance or a cleanout planned?</td>
</tr>
<tr>
<td>Can the tank be drained?</td>
</tr>
<tr>
<td>Design for now, or plan for the future?</td>
</tr>
<tr>
<td>How hard to add in the future?</td>
</tr>
</tbody>
</table>
# All Mixed Up? Water Tank Mixing Made Easy

The growing focus on water quality in on-site water tanks has many tank owners considering mixing. This chart helps identify the broad categories of means, active and passive, as well as specific types. But every tank and distribution system is different, and numerous factors go into selecting the mixing system that is best for you. We hope you find the information helpful, and if you'd like to discuss your specific situation and how it impacts the options below, contact us:  we love to talk tank mixing!

<table>
<thead>
<tr>
<th>Type</th>
<th>Manufacturer</th>
<th>Estimated Cost(1)</th>
<th>Size/Dependability (years)</th>
<th>Estimated Annual O&amp;M Costs</th>
<th>Electrical Requirements</th>
<th>Chemical Injections Option(2)</th>
<th>Design Tank to install (3)</th>
<th>Description</th>
<th>Comments</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Settler/Admixture Mixer</strong></td>
<td>$400</td>
<td>18 - 30</td>
<td>$300 - 600</td>
<td>230VAC, 20 amp/service</td>
<td>Yes</td>
<td>No</td>
<td>200 gal stainless steel unit, approximately 3 feet long and 30 inches round, sitting on a few inches above the tank bottom on feet, or suspended from the tank roof. Circulates water by inducing flow around the tank from the bottom and outward over the side. Also designed to circulate the water surface in layers causing direct and induced mixing effects. Power cord is run from ground, up shaft, through roof hatch to unit. Unit is connected to chain to access it.</td>
<td>Deep in through roof hatch (2&quot; pipe), powered, then turned on. Fits through 12” diameter roof hatch. Can be relocated via hatch for future maintenance or removal. Does not need to be wired to floor. Tank owners can install mixer during repairing, and also providing credit and writing up is powered by owner’s electricity.</td>
<td>Thousands throughout the US.</td>
<td></td>
</tr>
<tr>
<td><strong>PAI Water Mixer</strong></td>
<td>$400</td>
<td>10 - 100</td>
<td>$500 - 500</td>
<td>120/240VAC, 10,000 PSI, 12 inch drive, nominal power draw 500W, 240 VAC, 3/4 HP</td>
<td>Yes</td>
<td>Maybe</td>
<td>Stainless steel submersible motorized impeller device acts on the tank bottom in a flat bottom tank, or in reservoirs to the floor in an elevated tank, and circulates water throughout the entire tank from suction to the top. Power cord is run from ground, up shaft, through roof hatch to unit. Unit is connected to chain to access it.</td>
<td>Mixer mounted on tripod stand, does not need to be secured to floor or needs to be removed. Motor is sized to be 1/2 HP and 10,000 PSI. Typically fits through 14” roof hatch. The SCADA output, Option for solar power. Tank owners can install mixer during repairing, and also providing credit and writing up is powered by owner’s electricity.</td>
<td>Thousands throughout the US, various climates.</td>
<td></td>
</tr>
<tr>
<td><strong>PAI Heavy-duty Airfier/Agitator System</strong></td>
<td>$100 - 250</td>
<td>10 - 180</td>
<td>$500 - 500</td>
<td>20 amp, 120 VAC with single phase, 60 Hz rate, plus power for air compressor</td>
<td>No</td>
<td>Yes</td>
<td>This mixing system utilizes the injection of compressed air through a rising system from an air compressor at the base of the tank, up above the high water level, then down to the aerators at the bottom of the tank. The rising aspect of this system comes from the bubbles rising from the bottom to the top of the tank.</td>
<td>Chlorines to have 10% energy savings compared to other mixing technologies. Used for many years in a variety of other applications, like wastewater. Need to supply air piping/valving to supply tank walls inside and out, may require welding and cutting to be transported.</td>
<td>Towers of Installs throughout PA.</td>
<td></td>
</tr>
<tr>
<td><strong>Solution Admixture Mixer</strong></td>
<td>$400</td>
<td>10 - 180</td>
<td>000 - 1,000</td>
<td>solar powered</td>
<td>Yes</td>
<td>No</td>
<td>System is basically a flexible device, mounted on one end to the tank bottom, and flows to the top as the other with a solar powered motor spinning an impeller near the top of the water, then from the bottom of the tank, up through the top and out to the surface. Solar panel is fixed in place on tank roof near hatch, and cables run through hatch to supply power.</td>
<td>Brushless motor, solar panels, and digital control system outside of the tank. Solar receptors are protected under wind and rain,typically wall mounted and roofed. Largely (and elevated tanks) are from a lower maintenance point of view. Can be used in cold climates, with low pump concentration. CA. Noname Inc installs in tank sizes ranging from 3,000 to 5,000,000 gallons.</td>
<td>Installations across the US, with low pump concentration. CA. Includes noname Inc installs in tank sizes ranging from 3,000 to 5,000,000 gallons.</td>
<td></td>
</tr>
<tr>
<td><strong>Tank Shaker</strong></td>
<td>$40 - 650 (interior only)</td>
<td>10 - 120</td>
<td>1500 - 1,000</td>
<td>Power for booster pump - varies depending on size and tank height</td>
<td>Yes</td>
<td>No</td>
<td>Stainless steel and seats on bottom with one or more motorized locates 3-5 feet above the base of the tank, using an air powered water equalizer to approximately five times the distance. Flow through the motor is generated by booster pumps outside the tank, pumping water through uptake slits, roof, down to the tank. No moving parts or electrical equipment within the tank.</td>
<td>In cold climates, need insulation and heat tracing on source water piping from booster pump to tank roof entry point. Most contamination at the distribution point is due to high water levels and storage tank.</td>
<td>3 in Connecticut, NY: 1,000 gallon systems in CA and TX.</td>
<td></td>
</tr>
<tr>
<td><strong>UV/AOP (Air Piping Protection) by Sediment Tanks</strong></td>
<td>$100 - 250</td>
<td>10 - 180</td>
<td>1200 - 1,000</td>
<td>0.15 HP, 15% air, 1.5% effluent, 1 L/min, 1.5K RPM, single phase, 230V, 20 amp supply to air source</td>
<td>Yes</td>
<td>No</td>
<td>Uses jets of air to move water in tank. Air compressor at base of tank pumps air through pipe to the top of the tank.</td>
<td>Mixing rates can be scheduled according to specific mixing needs and at different pump energy periods. Similar technology to PPI/UV/Reactors system detailed above.</td>
<td>More than 100 installs.</td>
<td></td>
</tr>
</tbody>
</table>

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1. **In-tank operation systems** can be biased with active mixers to remove *T. thermophilus* (THMs).

2. **FAC/Titan/PAI - Admixture System**

3. **FAC/Titan/PAI - Admixture System**

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*For specific requirements, please consult with your local Entech representative.*
Lessons Learned

• Water systems are complex.
• Solution for one tank may not work for others.
• Understand system operations.
• Data, lots of accurate data.
• Technology is evolving, prices dropping.
• Plan for inspection and maintenance of mixer.
• Fix one problem...
• Water systems are complex.
Questions?

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