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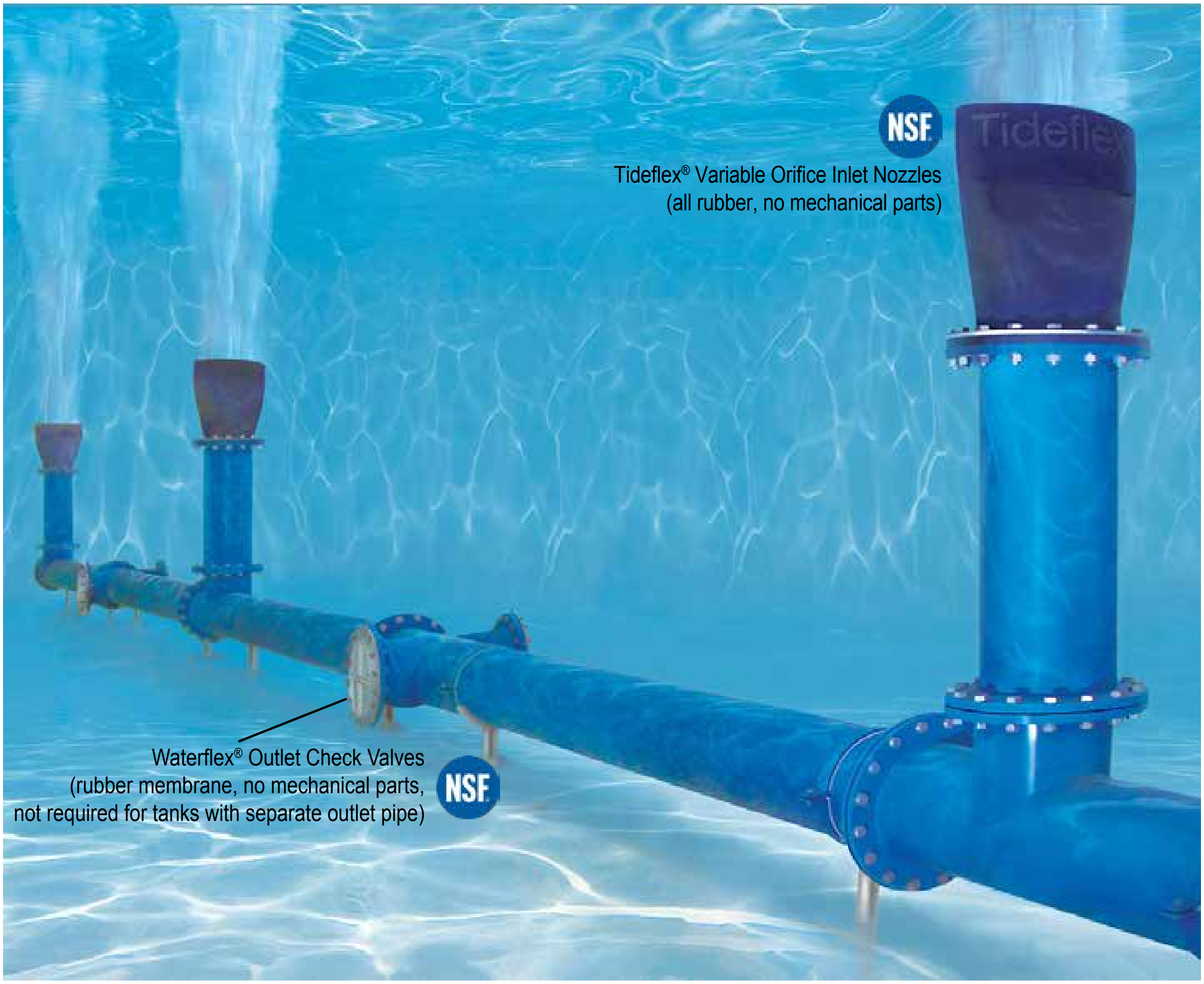
September 2024

Red Valve

Tideflex® Mixing System (TMS)

Custom Engineered Mixing Systems for Every Tank Style and Volume



Experience and Expertise Ensure Results

Since 1953, Red Valve has been the trusted leader in engineering innovative valves and mixing systems for the most challenging applications. Developed in the 1980's from a United States EPA grant, the Tideflex® Check Valve was created to solve backflow problems in outfall pipes.

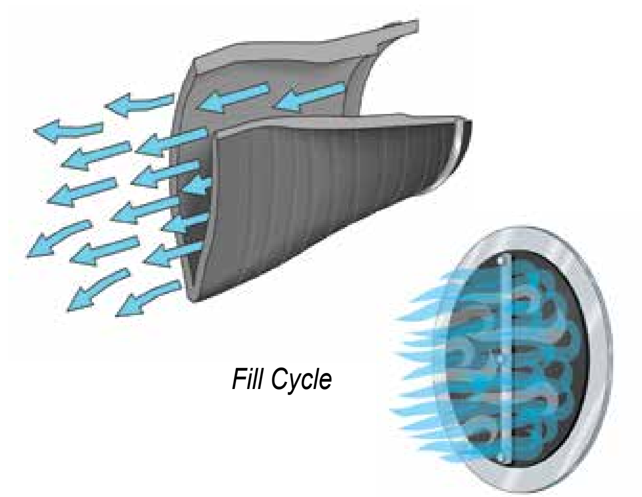
Red Valve Engineers further expanded the use of the Tideflex® Check Valve by developing it into a Variable Orifice Inlet Nozzle that provides superior mixing characteristics when compared to a fixed-diameter pipe.

When used as part of the Tideflex® Mixing System (TMS), the Tideflex® Variable Orifice Nozzles optimize jet velocity at all flow rates and discharge an elliptically shaped jet, producing rapid and complete mixing that improves water quality. The TMS also separates the inlet and outlet with one manifold pipe so short-circuiting is eliminated.

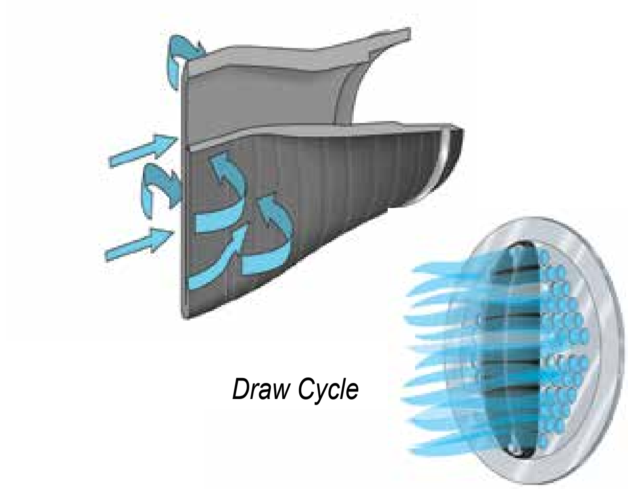
TMS is a truly green technology, requiring no outside energy source and virtually no maintenance, resulting in cost savings over a long life span.

Complete Mixing, No Short-Circuiting

TMS is a multi-port manifold system made of Tideflex® Inlet Nozzles and Waterflex® Outlet Check Valves operating solely on differential pressure. There are no mechanical parts. While the tank is filling, the Waterflex® Valves are closed and the tank fills through the Tideflex® Nozzles, mixing the tank completely. During a draw, the Tideflex® Nozzles are closed and water is drawn from the tank through flow efficient Waterflex® Valves. Unlike a fixed-diameter pipe, Tideflex® Nozzles act as a variable orifice, opening and closing with increasing and decreasing flow, maximizing jet velocity at all flow rates, producing rapid mixing with low head loss.



Fill Cycle



Draw Cycle

Features and Benefits of TMS

- Extensive CFD and Physical Scale Modeling
- Field validated for complete mixing of every tank style
- Tideflex® Variable Orifice Nozzles maximize jet velocity for rapid mixing
- No additional energy source required
- Virtually no maintenance
- Expected life is 30 years
- Complete system design with Mixing Analysis and Water Age Analysis
- Custom engineered for any tank style and volume
- Requires just one pipe penetration in tank
- Tideflex® Variable Orifice Nozzles and Waterflex® Outlet Check Valves are NSF 61 certified
- Passive and Active TMS available

TMS Solves Many Water Quality Problems

- Loss of disinfectant residual
- Spikes in Disinfection By-Products (DBP)
- Nitrification in chloraminated systems
- Bacteria and biofilm growth
- Variations in pH and dissolved oxygen
- Aging water
- Thermal stratification
- Taste and odor formation
- Mitigates ice formation

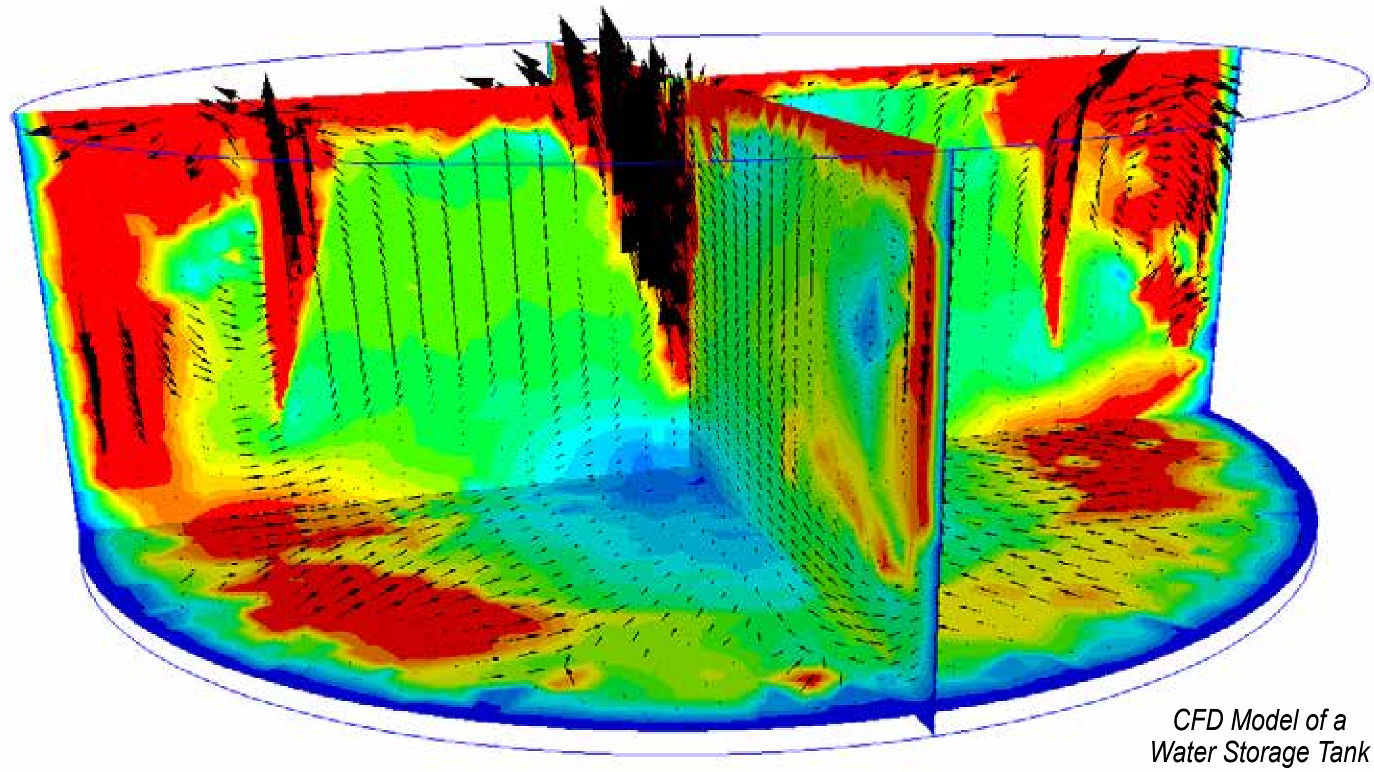
Custom Designed for Every Tank

Red Valve Engineers custom design every TMS based on tank style, material, volume, dimensions, flow rates and volume turnover. A TMS Design Report is provided including TMS drawings, TMS specifications, manifold hydraulics and Mixing and Water Age Analyses. The Mixing Analysis shows how much turnover is required to achieve complete mixing.

The Water Age Analysis provides the average water age under current or proposed operating conditions. Manifold hydraulics, mixing and water age models are run, as well as a jet trajectory analysis, to determine the quantity, size, orientation, elevation and discharge angles of both the Tideflex® Inlet Nozzles and Waterflex® Outlet Valves.

TMS Design Report

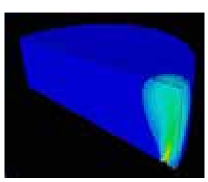
A Green Solution for Improved Water Quality



CFD Model of a Water Storage Tank

Limitations of Conventional Tank Design

Conventional tank designs typically incorporate single or multiple fixed-diameter inlet pipes, creating dead zones, short-circuiting, stratification and incomplete mixing. This piping configuration is very poor at mixing because it produces low jet velocity and concentrates all inflow momentum (the energy responsible for mixing) in one area of the tank. When concentrated in one place, a single fixed port will not effectively mix a tank. Problems with water quality are compounded in summer months when denser and negatively buoyant cold water enters the tank, causing it to sink. As a result, water at the bottom of the tank is mixed, but water in the upper part of the tank does not mix, getting hotter and older each consecutive day. This leads to a localized increase in water age inside the tank. Even with an opposing outlet pipe, thermal stratification is present. Contrary to popular belief, a separate outlet pipe does not prevent stratification or prevent short-circuiting.



Inlet flow in one location inhibits mixing.

Improved Mixing with Tideflex

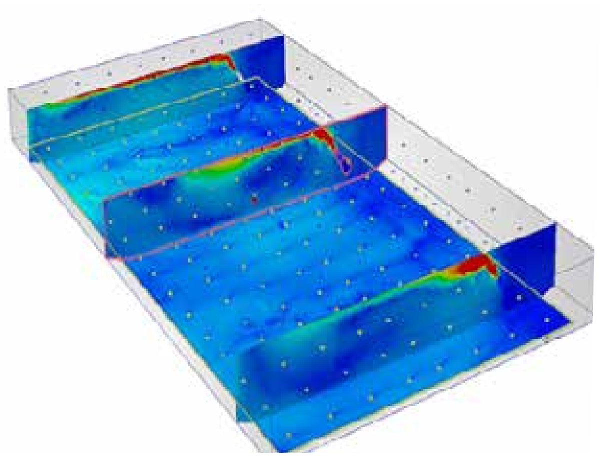
One of the keys to improving water quality in tanks is to ensure the water is mixed to prevent short-circuiting and dead zones. By design, the distribution system utilizes existing pumps and valves, which then return each tank back to its high water level. During a fill cycle, fresh water passes through multiple Tideflex® Nozzles, creating a circulation pattern throughout the entire water volume. This rapidly and completely mixes new water throughout the tank. Once the tank is mixed during the fill cycle, it does not "unmix" during the draw cycle.

Unlike mechanical mixers, TMS requires no additional energy to mix tank water. Mixers submerged or floating inside the tank add substantial operation and maintenance costs, as motors must be replaced every few years, usually requiring the tank to be drained.

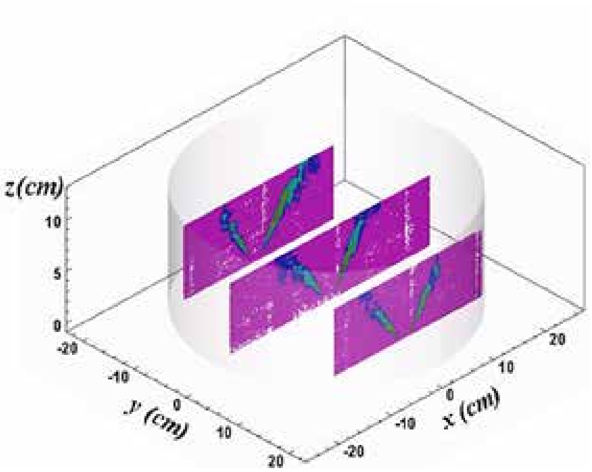
For tanks with minimal or no turnover, mixing 24/7 will not prevent water quality decay, as mechanical mixers just mix continually aging water.

Computational Fluid Dynamics (CFD) Modeling and Physical Scale Modeling

Continuous CFD Modeling has allowed Red Valve Engineers to optimize TMS designs and configurations. Hundreds of CFD Models have been conducted for virtually every size and style of storage tank.

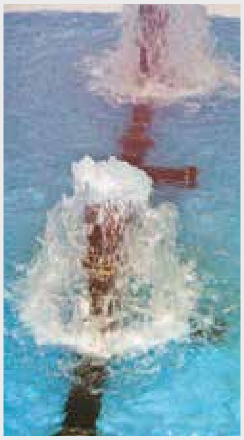


Partnering with the Georgia Institute of Technology on a Water Research Foundation (WRF) project titled "Physical Modeling of Mixing in Water Storage Tanks," hundreds of experiments were conducted on single and multiple-port manifolds to analyze mixing characteristics. Virtually every size and tank style was modeled under isothermal, negatively buoyant (colder inlet water) and positively buoyant (warmer inlet water) conditions.



TMS designs are based on the most efficient manifolds found during this project. The TMS has also been validated with independent scale modeling.

Multiple Variable Orifice Tideflex® Nozzles



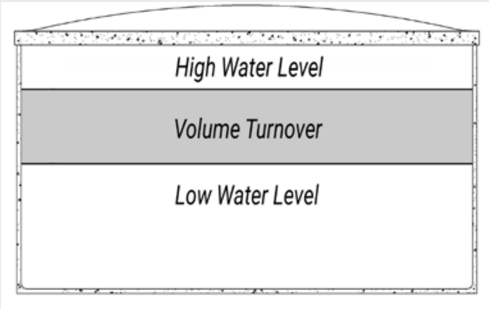
Traditional single inlets, where the flow is concentrated in one location, result in short-circuiting and stratification. The effect is worsened in summer conditions when inlet water is significantly colder than the tank water. TMS solves this problem with rapid and complete mixing due to multiple Variable Orifice Tideflex® Nozzles that produce at least 75% faster mixing than a single fixed-diameter pipe.

Maximized (Non-Linear) Jet Velocity of Tideflex® Nozzles Provides Rapid Mixing

Unlike fixed-diameter pipes, Tideflex® Nozzles act as a variable orifice. They open and close with increasing and decreasing flow which maximizes jet velocity at all flow rates, producing rapid mixing with low head loss.

Maximize Turnover, Minimize Water Age

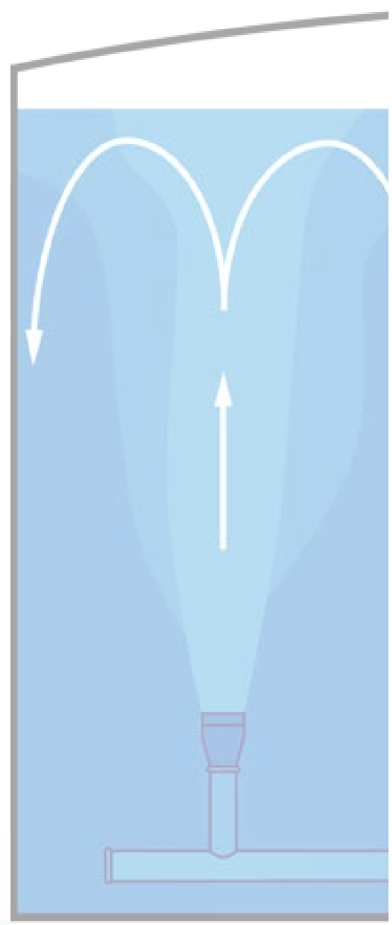
Water tanks are designed to have volume turnover and need turnover to minimize water age. For example, a 5% daily volume turnover = 20 day average water age, 10% turnover = 10 day water age, 20% turnover = 5 day water age, and so on. AWWA recommends a 20-30% turnover for a 3-5 day water age. Water utilities should operate their systems to maximize tank volume turnover. This minimizes water age, increases disinfectant residuals, reduces DBPs and significantly improves water quality.



TMS in Circular, Rectangular and Irregular Reservoirs

In circular, rectangular and irregular-shaped reservoirs, the diameter or length is greater than the depth. The single fixed-diameter inlet pipe results in short-circuiting, poor mixing and dead zones in areas away from the inlet. This is caused because momentum is concentrated in one localized area of the tank.

TMS achieves complete mixing through a horizontal manifold with multiple Tideflex® Inlet Nozzles that distribute the momentum across the tank. Manifold hydraulics and mixing and water age models are run, as well as a jet trajectory analysis, to determine the quantity, size, orientation, elevation, and discharge angles of both the Tideflex® Inlet Nozzles and Waterflex® Outlet Valves. Waterflex® Outlet Valves are strategically located on the manifold to eliminate short-circuiting. For tanks with separate inlet and outlet pipes, TMS is installed on the inlet pipe.

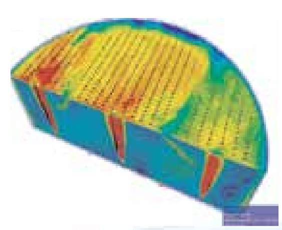


Problem

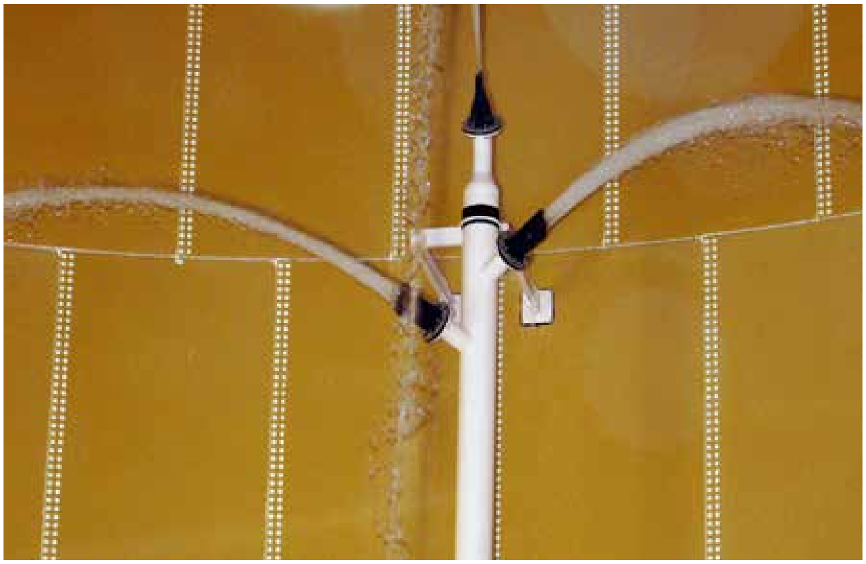
Reservoirs are prone to short-circuiting, as a single fixed-diameter inlet pipe cannot distribute inlet flow momentum through the entire water volume.

Solution

Multiple Tideflex® Inlet Nozzles circulate water through the entire tank volume and completely mixes the water with every cycle.

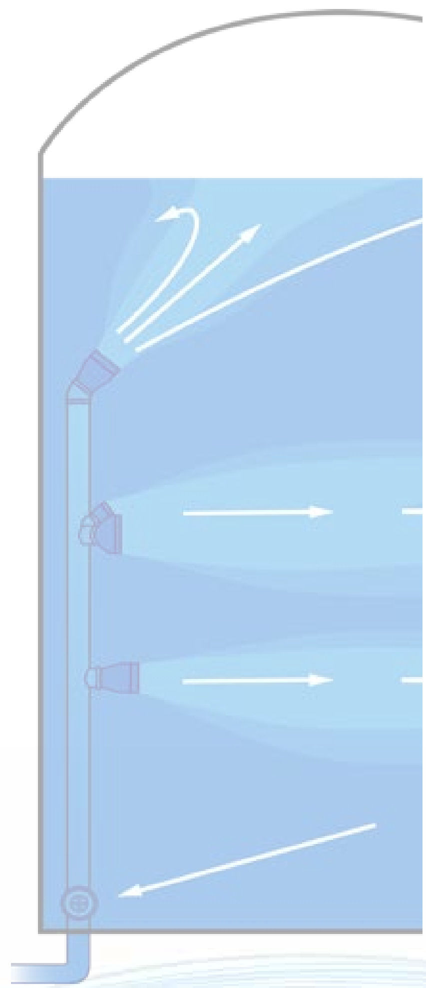


TMS in Standpipes



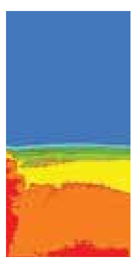
Standpipes are greater in depth than diameter and can exceed 140 feet (43 meters) tall. They are extremely prone to short-circuiting, incomplete mixing and water quality decay, especially in summer when colder inlet water sinks, resulting in temperature stratification and increased water quality issues.

TMS uses a vertical manifold with multiple Tideflex® Inlet Nozzles at various elevations and angles, distributing momentum throughout the depth of the tank and achieving complete mixing. Manifold hydraulics, mixing and water age models are run, as well as a jet trajectory analysis, to determine the quantity, size, orientation, elevation, and discharge angles of both the Tideflex® Inlet Nozzles and Waterflex® Outlet Valves. Waterflex® Outlet Valves are strategically located on the bottom of the TMS riser to eliminate short-circuiting. For tanks with separate inlet and outlet pipes, TMS is installed on the inlet pipe.



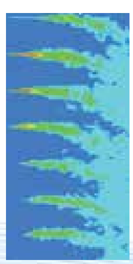
Problem

Due to their depth, standpipes are prone to short-circuiting, incomplete mixing and poor water quality.



Solution

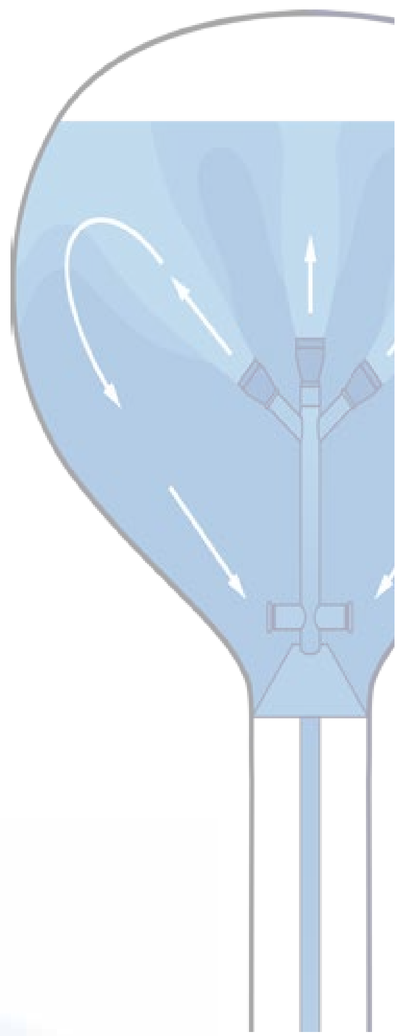
Complete mixing is achieved by having Tideflex® Inlet Nozzles at various elevations and discharge angles.



TMS in Dry Riser Elevated Tanks

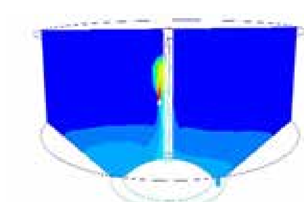
Elevated tanks are prone to poor mixing in summer and icing in winter due to large surface area exposed to the sun and hot and cold temperatures. The inlet-outlet pipe of Sphere-Spheroid, Fluted-Column and Composite Elevated Tanks (CET) runs up the pedestal (or dry riser) and penetrates the bottom of the bowl.

For tanks with common inlet and outlet pipes, TMS is designed as a vertical manifold with Waterflex® Outlet Valves near the bottom of the bowl. This separates the inlet and outlet pipes and eliminates short-circuiting. Multiple Tideflex® Inlet Nozzles are located at various elevations and discharge angles along the vertical riser to achieve complete mixing and mitigate icing. Manifold hydraulics, mixing and water age models are run, as well as a jet trajectory analysis, to determine the quantity, size, orientation, elevation, and discharge angles of both the Tideflex® Inlet Nozzles and Waterflex® Outlet Valves. For tanks with a separate outlet pipe, TMS manifold is installed on the inlet pipe.



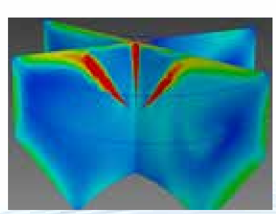
Problem

With their unique bowl geometry, elevated tanks are prone to poor mixing, stratification and water quality degradation.



Solution

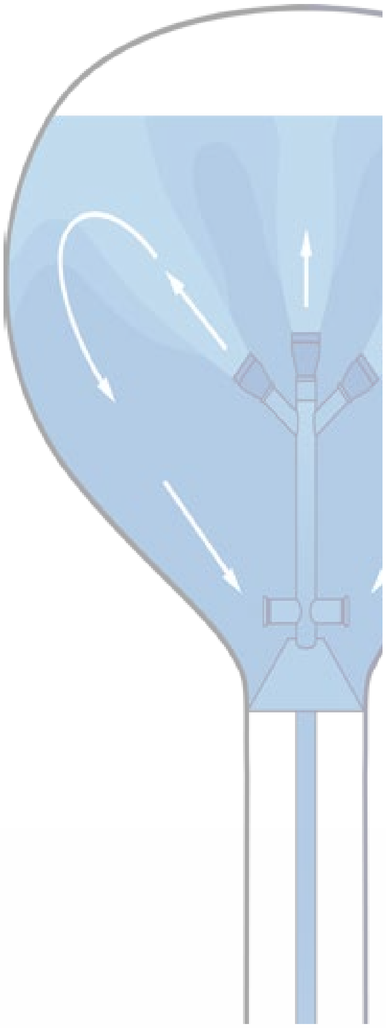
Multiple Tideflex® Inlet Nozzles at multiple angles and elevations completely mix the tank water.



TMS in Wet Riser Elevated Tanks

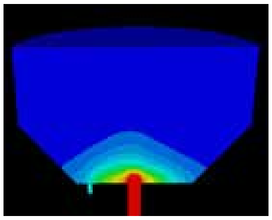
Multi-column or multi-leg tanks are highly prone to water quality issues. The inlet-outlet pipe penetrates the wet riser at ground level and is much smaller than the wet riser that is typically 3-12 feet (1-4 meters) in diameter and runs from ground level to the bottom of the bowl. When inlet flow discharges from the inlet-outlet pipe into the wet riser, the inlet flow velocity is severely reduced and flow momentum is extremely low when water enters the bowl making these tanks extremely prone to thermal stratification and short-circuiting especially in warmer months when inlet water is colder and negatively buoyant.

To achieve complete mixing, Tideflex® Inlet Nozzles are located up in the bowl at the top of the vertical riser. Manifold hydraulics, mixing and water age models are run, as well as a jet trajectory analysis, to determine the quantity, size, orientation, elevation, and discharge angles of both the Tideflex® Inlet Nozzles and Waterflex® Outlet Valves.



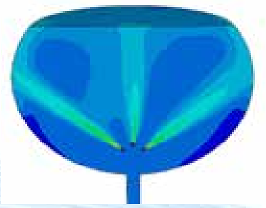
Problem

Wet risers drastically reduce inlet flow momentum, resulting in short-circuiting and stratification as only the bottom of the bowl gets mixed.



Solution

The entire tank is mixing through multiple Tideflex® Inlet Nozzles in the bowl. This configuration improves water quality and also mitigates ice formation.



Overflow Pipe and Drainpipe Protection

End of Pipe Tideflex®

Municipalities are challenged with protecting water storage tanks against contamination. Tideflex® Check Valves provide a reliable, cost-effective and virtually maintenance-free solution to prevent insects, rodents, birds and airborne pathogens (that can cause serious health risks) from entering tanks.

Unlike mesh screens and flap gates, the all-rubber construction of Tideflex® Valves will completely drain after an overflow, will not corrode or freeze open or closed in cold climates, will discharge debris during an overflow preventing clogging, and will prevent airborne pathogens and cold drafts from entering the tank, mitigating ice formation. Tideflex® Check Valves are either flanged or clamped to the end of the overflow pipe and can be installed at any discharge angle.

In-Line Overflow Security Valve (OSV)

Red Valve's innovative Overflow Security Valve (OSV) incorporates a Tideflex® Check Valve inside an assembly, hiding the check valve and making it difficult to manipulate or damage. The OSV is either welded or flanged within the overflow pipe and can be located at a higher elevation above ground level as an additional deterrent to vandalism. Red Valve Engineers provide a detailed Overflow Pipe Hydraulic Analysis to size and specify location for the Tideflex® Valve, OSV, and/or Dechlorinating Overflow Security Assembly (DOSA), based on tank dimensions, overflow pipe size and material, air gap distance and peak flow rate.

Dechlorinating Overflow Security Assembly (DOSA)

Storage tank overflows are rarely planned, with little time to react. Discharging chlorinated water into a stormwater system or land can be harmful or toxic to aquatic life and plants and can result in regulatory penalties. Red Valve Engineers created the patented DOSA technology to prevent intrusion of birds, insects and airborne pathogens, increase tank security and automatically remove chlorine residuals during discharge. The innovative DOSA is constructed of dual Tideflex® Nozzles and an internal adjustable dechlorination tube for dechlor tablets, completely encased in a non-clog epoxy-coated steel or stainless steel body.

The Dechlorinating Overflow Security Assembly (DOSA) is covered under the following patent numbers: US 10,538,438 (US); CA 2,934,752 (Canada).

Pass-Active and Stand Alone-Active TMS Applications

The Passive TMS has been proven to mix tanks with as little as 5% volume turnover. For tanks that experience periods of extremely low turnover or extreme cold, the Passive TMS is easily made into an Active TMS using a recirculation pump, creating the Pass-Active TMS. The passive TMS is easily installed in the tank and virtually no maintenance is required. The recirculation pump is installed in the valve vault or an adjacent structure, where mechanical parts are easily inspected and maintained.

The pump is low flow and low head as it pulls water from the tank and puts it back into the tank through TMS or a dedicated Tideflex® Nozzle. The pump only turns on when needed. It is a widely used and proven active mixing technology, in service for decades. Red Valve also designs Stand Alone-Active TMS which provide 24/7 active mixing as an alternate to mechanical mixers. It is a completely separate manifold that is not connected to the inlet or outlet pipes and uses a recirculation pump.

Safer, Easier Chemical Injection

TMS can also be used for chemical injection to boost residuals in storage tanks in free chlorine or chloraminated systems. Chemicals are injected into the inlet pipe during a fill or recirculation cycle and TMS completely mixes them throughout the entire tank volume. Red Valve Engineers perform a Mixing Analysis to provide the fill time required for complete mixing. This method results in a homogeneous solution in the tank and more consistent water quality leaving the tank. This eliminates the need to climb to the top of the tank to add chemicals.

Red Valve offers a worldwide, world-class custom service network. With corporate offices in Pittsburgh, PA, manufacturing facilities in Gastonia, NC, and a network of sales representatives around the globe, Red Valve has the sales engineering team to help you select the best choice of valves and related products for your applications.

Red Valve®

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750 Holiday Drive, Suite 400, Pittsburgh, PA 15220 | 412.279.0044 | support@redvalve.com | RedValve.com