Winter is Coming. Are your Water Tanks Ready?

How Active Mixing Prevents Ice Damage in Water Tanks

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Introduction

Winter is coming across the northern hemisphere, and water utilities gear up to battle the cold and its impact on their distribution systems. Mains break and service outages keep work crews and operators busy. Water tanks may not get the attention they need. Monthly inspections may not happen as planned.

As winter approaches, temperatures outside the water tank drop. In an un-mixed water tank, thermal stratification breaks down. The warm top layer can drop to the bottom of the tank and the cold moves up, bringing bottom sediments with it and compromising water quality.
As temperatures continue to drop, ice can begin to form both inside and outside the tank. In this post we look at what happens to water tanks during the winter and how you can protect your tanks.

Winter in Water Tanks

Where Ice forms

All aboveground water tanks located in cold climates are susceptible to freezing. They're exposed to the elements where wind and cold quickly dissipates any heat from the water in the tank. Elevated tanks are, in particular, prone to ice formation.

Collars (or Ice Donut)

As air temperatures drop, ice first begins to form on the sides of the tank exposed in response to the fill-drain cycle. With each cycle of rising and falling water levels, another layer of ice can form. These collars become very thick and heavy, with consequences for tank integrity.

Floating Ice

Depending on tank operations, a layer of floating ice can develop. The thickness increases with continuing cold weather and static water conditions in the tank.

Vents and Overflows

Vents are designed to allow air in and out of the tank in response to the fill cycle. Overflows allow water out when the tank gets too full. The screens covering vents and overflows that prevent insect egress in summer can become blocked with ice, reducing or eliminating air and water flow. Slowly leaking overflows allow ice to form on the outside of the tank.

Tank Damage from Ice

Operationally, ice forming in a tank reduces its storage volume. This impacts drinking water supply and fire-fighting reserves. The physical damage ice causes can be extensive and expensive to fix.

Coatings and Internal Appurtenances

Heavy collars of ice can dislodge ladders and piping from tank walls. Floating ice moves up and down as the water level fluctuates, rubbing the sides of the tank. This action damages the coating and internal appurtenances.

Blocked Air Vents and Overflows

When vents designed to protect tanks from overpressure are blocked with ice, hoop stress loads on the steel and seams may cause the tank wall to fail.
Overflow from a tank causes ice formation on the outside of the tank. These icicles can become very heavy, heavier than anticipated in tank design.

Weight of Ice in Elevated Tanks

Pressures created during the daily freeze/thaw cycle can bend or break a water tank. Ice is heavy as well, and the additional weight may cause the tank to collapse.

At **-7.6 °F/-22°C**, the pressure exerted by freezing water can reach **40,000 psi**
- A Johnson, Sciencing[1]

Traditional Ice Prevention methods in Tanks

Design

In cold climates, the design of a water tank is the first line of defense against damage from freezing water. The AWWA standard M42 identifies design specification elements that should be considered when designing water storage tanks for cold climates. Keeping key appurtenances, like ladders and overflow pipes above the water line, for instance, reduces the risk of ice damage.

Once a properly designed tank is in place, operational actions can impact ice formation in water tanks.

Operational Actions

There are some operational methods aiming to prevent or reduce ice formation in tanks that have been used for years, with varying degrees of success.

Water Turnover

A common approach is trying to circulate water within the tank by pumping the water. By maintaining enough turnover, you prevent ice formation. However, moving water around uses significant amounts of energy and in some systems may not be operationally possible.

Tanks can be equipped with pumps to recirculate warm in-coming water from the bottom of the tank up to the top. With enough pumping power, this can prevent ice formation by warming upper layers and keeping the water moving. Depending on the size of the tank, however, this uses a lot of energy.

Insulation

Insulation helps hold the heat in the tank, reducing ice formation. However, this can be an expensive option that usually only delays the inevitable. If temperatures remain cold, heat is lost regardless of the amount of insulation.

Heaters

In extremely cold climates, tanks may need to be equipped with heaters. However, not only do heaters come with a high energy cost, they may not prevent ice formation in the tank. The heater must be able to warm the water in the bottom of the tank enough to make it rise. If it doesn't get warm enough, cold water at the top of the tank will still freeze.

Benefits of Active Mixing

Active Mixing Prevents Ice Formation in Tanks

It seems traditional methods may not be the best to prevent ice damage in water tanks. As technology advances, new solutions emerge. A new solution, active mixing, is important for maintaining water quality during warmer months, and prevents ice formation in winter as well.

Active mixing reduces and eliminates ice formation

Active mixing works by pulling warmer, denser water from the bottom of the tank up into the cold upper layer. Used continuously, active mixing maintains all the water in the tank at a constant temperature. Keeping the water moving means ice doesn't have a chance to form.

Active mixing increases efficiency of heaters

In extremely cold climates, it may take more than one tool to prevent ice damage. Heaters may still have to be deployed to keep the water from freezing. Here again, active mixing helps by actively moving the heated water up into the colder layers, greatly increasing the efficiency and effectiveness of heaters.

Active Mixing Improves Water Quality Year Round

A major impact of ice formation in water tanks is damage to the lining. Collars, some call them donuts, of ice can pull the coatings off the tank wall while floating ice abrades and damages them. Damaged coatings are susceptible to biofilm growth in warmer weather, and contamination and corrosion become real risks.

Active mixing eliminates ice formation, reduces wear to coatings and appurtenances and improves water quality all year round.

Conclusion

Every winter, across northern latitudes, water utilities battle the cold in order to maintain a water supply in freezing conditions. Ice can form quickly and once it does, it's hard to get rid of before spring. Ice in the tank damages internal piping and coatings. Ice collecting on the outside of an elevated tank can cause catastrophic failure.

Active mixing is important for maintaining water quality during warmer months and prevents ice formation in winter as well. The key is to install an active mixer before Winter comes. By mixing your tank before there is a problem, you lower operational costs and costs that can result from ice damage.

About the Author – Lucy Allen
Lucy Allen is the Municipal Business Development Manager at Kasco. With more than 12 years of experience in the water and wastewater industry, she has a strong technical background and extensive field experience, along with relationship building skills that enhance market presence within the water utility market. Lucy holds a Bachelor of Science degree from Michigan State University.

[1] https://sciencing.com/water-freeze-4600114.html.
[2.] https://www.awwa.org/Store/Product-Details/productId/39928968.