HCAA ADVISORY NOTE ON METALLIC WATER STORAGE TANKS FOR DRINKING WATER STORAGE

JUNE 2024

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For Drinking Water Tanks Serving Buildings with Large Water Demands and/or High Tank Infill Rates

The HCAA have been advised of 14 drinking water storage tanks suffering from corrosion between the top waterline and the tank roof/lid. Based on details reported by our members the figures show this to be less than 5% of the tanks sold over the last two years and less than 0.5% of the tanks cleaned over the last 10 years.

The majority of the drinking water tanks installed in Australia use 304 stainless steel. Out of the incidence observed 15% of the tanks were made of a greater material than 304.

78% of the drinking water tanks suffering from corrosion between the top waterline and the tank roof/lid did **NOT** have on tank automatic chlorine dosing.The HCAA were not provided with any details on the chlorine content within the tanks so assume they contained free chlorine below 2mg/L for 304 and below 5mg/L for 316 and 2205 stainless at ambient temperature. Also not exceeding the safe drinking water limits prescribed by the Australian Drinking Water Guidelines.

This advisory note is not written to address the technical nature of the corrosion and root causes but is intended to provide a potential approach to mitigate the severity of any above waterline corrosion.

The current understanding of the issue

Drinking water storage tanks with or without onsite chlorine dosing have been observed to have corrosion, stains, and minor pitting within the material, as shown in the photo below.

INSERT PHOTO

The HCAA nor any of its affiliates have undertaken any scientific research or laboratory testing in relation to this phenomenon.

It is speculated that this corrosion is brought on when the drinking water tank supplies a facility with a high turnover of water, which is accompanied by a high fill flow rate (vigorous discharge of water into the tank).

The vigorous discharge of water into a body of water generally assists with the release of gases from the water. It is also speculated that the water supply has a large chlorine demand due to the water containing organic organism and minerals that the chlorine or chloramine oxidises against.

As part of the oxidization process, chlorine gas is created The gas is 2.5 times heavier than air. This gas will generally lay on top of the water within the tank and in some instances is observed to be disturbed by the tank infill valve water discharge. Where water condenses on the tank inside walls, or aerosol droplets are formed when the tank fills, the hydrogen and oxygen atoms within the water combine with the chlorine gas to create HOCl, which is hypochlorous acid. As the hypochlorous acid is in a reasonably concentrated form it can be quite aggressive to stainless steel and other metals.

Furthermore, as the plant rooms that drinking water storage tanks are located in are not generally airconditioned, the zone between the top waterline and the tank roof/lid are subjected to the external atmospheric temperature which can be expected to exceed 20˚C. Temperatures in excess of 20˚C further exacerbates the corrosion effect of hypochlorous acid on stainless steel and other materials.

It has been speculated that removal of the chlorine gas from the tank will reduce the corrosion effect or the utilization of grade 2205 stainless steel may prolong the duration before pitting occurs, noting that neither of these have been scientifically proved to avoid corrosion.

However, a mechanical ventilation system has been fitted to a drinking water tank post experiencing corrosion between the top waterline and the tank roof/lid. Based on details reported by our members this drinking water tank is located within the Nepean area, and since fitting the mechanical ventilation no future corrosion has been observed over the last 12 month period since fitting.

It is speculated that this phenomenon has not been observed within fire water storage tanks, due to the chlorine or chloramine being dissipated from the tank and not replenished on a regular basis given the lack of constant water usage from a fire tank.

This should not be misconstrued as suggesting that this situational corrosion could not occur on fire water storage tanks or other water storage tanks including pipework and components.

Ventilation approach to reduce corrosion

The air space between the top waterline and the tank roof/lid should be provided with a mechanically fan forced supply and a fan forced exhaust system.

It would be recommended to achieve 10 air changes per hour within the tank, and achieve a minimum velocity across the water surface of a minimum of 0.5m/sec with an aim of 1.1m/sec .

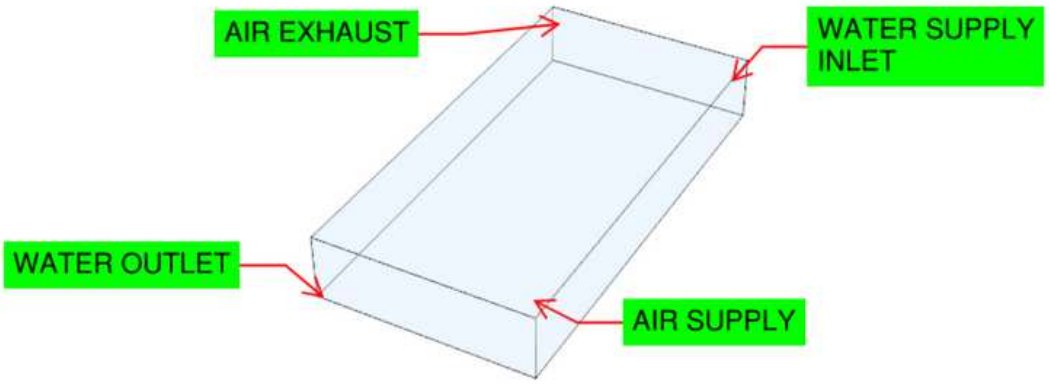
The supply duct and fan should pressurize the area between the top waterline and the tank roof/lid to avoid dust, insects and other infectious particles entering the drinking water storage tank.

The exhaust duct and fan should draw air from close to the top water level in order to remove the heavier than air gas layer. The exhaust fan should be at a lesser flow rate than the supply fan to avoid dust, insects and other infectious particles entering the drinking water storage tank.

The inlet and outlet duct should be located on diagonally opposite sides of the tank to minimize dead air spots.

Furthermore, the inlet and outlet ducts should flow in the opposite direction to the water supply inlet and water supply outlet, ie the outlet exhaust should be on the same side of the tank as the water supply inlet.

For clarification a diagram has been shown below (noting the geometry of some tanks requires some thought and consideration by the design team involved):



Exhaust discharges should be discharged in accordance with the Building Code of Australia, AS1668, and any other project consideration deemed fit for purpose. It would be recommended to have a practicing HVAC mechanical engineer preside over the discharge location.

The tank air inlet duct shall be screened to prevent the inlet of dust, insects and other infectious particles entering the drinking water storage tank by use of an air filter between 3-0.3 micron.

Both the supply and exhaust fans should not be located above the tank to enable ease of replacement and should be located where the fan can be easily replaced.

It is suggested that the replacement of the fans is included in the operational and maintenance manuals for the facility.

Predefined parameter mechanical ventilation design

Affiliate drinking water tank suppliers such as Tasman Tanks and Tank Vision, have engaged with mechanical engineers to provide basic predefined parameter tank mechanical ventilation systems, that can be used by installers to adequately procure and install the required components within the boundary conditions of the predefined parameters.

Any departures/changes to the predefined conditions will require the installer or designer to engage or engage with a mechanical engineer or designer to critically assess the changes and ensure fit for purpose.

Hydraulic designers or engineers should make louver provision, space provision and provide adequate documentation for tender awareness of the mechanical tank ventilation system.

Project mechanically engineered solution

Should the project have a mechanical engineer engaged as part of the project, the hydraulic designer or engineer should coordinate the requirements and the like with the project mechanical engineer to design a fully integrated mechanical tank ventilation system which suits the built form and any discharge constraints.

The hydraulic designer shall coordinate and document the flanges/connections left on the tank for the mechanical ventilation system to be connected to.

BMS Monitoring

It would be a recommendation of this advisory note that monitoring of the following parameters within the drinking water tank are undertaken where a BMS is available and the client is excepting of the costs.

The BMS shall take data every 5 mins and record;

- Air zone in tank
  - relative humidity
  - temperature

- Water zone in tank
  - temperature
  - pH
  - free chlorine
  - total chlorine

- Mechanical tank ventilation system
  - supply fan fail
  - exhaust fan fail

Water samples that should be considered to be taken and trended by the operator from time to time;

- Chloramine / monochloramine
- Chloride
- Alkalinity kH
- Dissolved oxygen

Other Noteworthy Items in Relation to Drinking Water Tanks

The following are items designers and engineers should generally consider;

- Ensure the tank location complies with AS3666 and is not subject to solar gain,
- The tank filling and tank outlet are on adjacent sides (opposite ends) of the tank, to encourage water turn over within the tank and assist in managing water age.
- Where chlorine dosing is provided ensure the connections to the tank (from the dosing circulating pipes) are below the water level and do not cause any splashing. Furthermore, ensure the circulation system flows in the opposite direction to the tank filling and tank outlet once again to encourage water “stirring”,
- The installer and tank supplier should supply the client with a best practice cleaning and inspection process to ensure best management of the tank and water hygiene,
- The overall water service installer should give consideration to the chlorine demand of the facility, the operational nature and assist the operator produce a management plan,
- Provide automatic cleaning filter of <5micron to assist with organic material removal, (note this is not technically correct as nanofiltration is the way to remove organic material)

Further Consultation

The HCAA suggest that consultation is undertaken with the tank supplier, mechanical engineer, metallurgist, chemical engineer and other subject matter experts to avoid any unintended consequences.

You may wish to seek assistance from the Australian Stainless Steel Development Association (ASSDA) https://www.assda.asn.au/ or other industry bodies.

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