

Startup of Galvanized Cooling Towers

Cooling towers that have galvanized metal require special care during startup. Systems not properly treated at start-up may experience:

- Rapid corrosion of the new galvanized cooling towers referred to as “white rust”
- Deposition of dirt and debris in the piping and heat exchange equipment.
- Microbiological control issues.
- Fouling from oil and greases.

To minimize these problems, galvanized towers should be pre-cleaned and passivated before they are put into service. The following is a summary of the 3 steps in the startup process:

1. **Pre-Cleaning:** The piping system needs to be cleaned and flushed to remove any oil, grease and other suspended solids left during construction. An alkaline product like Q-ALK PC should be used to clean the piping system, but only if the galvanized metal can be bypassed so **the Q-ALK PC does not come in contact with galvanized metal. A surfactant like ChemWorld 68 should be used if the galvanized metal cannot be bypassed.** The cooling systems should be drained and flushed after the pre-cleaning.
2. **Feed Passivation Product:** Refill the tower and add Pre-Q 331. Pre-Q 331 has a high level of phosphate that helps promote the formation of the greyish colored, zinc-carbonate passivation layer. Circulate the Pre-Q 331 for 12 to 24 hours without a heat load on the tower. Open the cooling tower blowdown at the end of this step to reduce the phosphate level in the cooling water. When the PO₄ level in the cooling water has dropped to below 15ppm, the long-term cooling tower treatment program can be started.
3. **Startup Water Chemistry (First Two Months):** The cooling water chemistry has to be controlled within specific guidelines to ensure that the galvanized coating is thoroughly passivated. That includes keeping the cooling water pH between 6.5 and 8.0 and the hardness between 100 and 300 ppm. The table below summarizes several major tower manufactures guidelines for initial treatment of galvanized cooling towers and associated cooling systems:

Cooling Tower Manufacturers –Start-up Water Chemistry			
Parameter	BAC	Evapco	Marley
Passivation Treatment	Use of inorganic PO ₄ treatment helps passivate the zinc coating	400-450 ppm PO ₄ for 45 – 60 days	Use inorganic PO ₄ for at least 8 weeks to help passivated the zinc coating
pH	6.5 – 8.0	6.5 – 8.0	6.5 – 8.0
Hardness (as CaCO ₃)	>30	100 – 300 ppm	100 – 300 ppm

The passivation process can be considered complete when all of the galvanized metal has changed in appearance from bright and shiny to dull grey. Detailed information on the cleaning and passivating of galvanized towers can be found on the following pages, along with information on treating towers that have experienced white rust.

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System Pre-Cleaning

It is critical to clean the cooling tower and piping of any dirt, debris, oil and greases before the system is put online. The cooling tower deck, basin and sides should be cleaned of any loose dirt and debris and the system should be filled with water and flushed. An alkaline cleaning product like Q-ALK PC should be added to assist in cleaning the piping system of oil and grease, however, **the Q-Alk PC should only be used if it the galvanized surfaces can be isolated so the cleaning solution does not come in contact with the galvanized metal.** If the galvanized metal cannot be bypassed, than a neutral pH cleaning surfactant like ChemWorld 68 should be added to help clean the piping.

Instructions for using Q-Alk PC:

- Where possible, heat the water in the system to 130-180°F. Heating speeds the reaction and reduces the time and/or the concentration of the cleaning solution required to clean the system.
- Add Q-ALK PC at the rate of 0.5-1.0% (i.e. 0.5-1.0 gallons of Q-Alk PC per every 100 gallons of cooling system volume).
- If the system water is heated to the recommended temperature, cleaning should be completed in 12-24 hours. Where heating is not possible, the solution can be safely circulated in the system for several days.
- After the circulating time has been reached, the system should be drained and flushed with clean, clear water until the flushing remains clear.

Instructions for Using ChemWorld 68

- Where possible, heat the water in the system to 130-180°F. Heating speeds the reaction and reduces the time and/or the concentration of the cleaning solution required to clean the system.
- Add ChemWorld 68 at the rate of 200-300 ppm (i.e. 4 pounds of ChemWorld 68 per every 1000 gallons of cooling system volume).
- ChemWorld 68 is designed to be a low-foaming surfactant, however, a defoamer like DeFoam S should be on hand in case of excessive foaming.
- Circulate for approximately 24 hours and drain and flush the system.

New System Startup

Feeding Passivation Product (Pre-Q 331)

Pre-Q 331 is normally shot fed to the system adding 17 lbs per 1000 gallons of system volume into the sump of the tower and then recirculating the water for 12 to 24 hours with no bleed-off and no load. This should develop a phosphate level of approximately 400 ppm in the system. Longer circulation times are beneficial. When the circulation is complete, open the cooling tower blowdown while continuing to circulate without load. When the phosphate residual in the system is reduced to <15 ppm, the regular treatment can be initiated and the system started up for normal operation. Less concentrated versions of Pre-Q 331 are available for smaller systems.

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Startup Water Chemistry

The water chemistry needs to be controlled with the following limits for the first 2 months or until a dull grey passivated layer can be observed on the galvanized metal surfaces:

- Total Hardness: 100 to 300 ppm as CaCO₃
- Total Alkalinity: 100 to 300 ppm as CaCO₃
- pH: 6.5 to 8.0
- Sulfate: less than 1,200 ppm
- Chloride: less than 450 ppm
- Free Halogen : less than 0.5 ppm(Cl- or Br-):

Systems That Have Experienced White Rust

The first step in dealing with a tower that has white rust is to confirm that the deposit is white rust (zinc hydroxide) and not a calcium scale deposit. Samples of the deposit should be sent to a qualified lab to confirm that white rust has occurred.

Once white rust has been confirmed, the deposits should be removed with a soft bristle brush followed by coating the damaged areas with a zinc-rich galvanizing paint. If the white rust is light or spotty with minimal evidence of metal damage or corrosion, the deposit may simply be washed off. The following are recommended Zinc-rich Paints that can be applied to repair damaged galvanized surfaces

- **ZRC Worldwide** - ZRC Cold Galvanizing Compound
- **Sherwin Williams** - Zinc Clad XI
- **Benjamin Moore & Co.** - Epoxy Zinc Rich Primer CM18/19

In all cases after removal, the tower should be returned to “passivation water chemistry conditions” and re-passivated as described above for new towers.

Alternate Method for Passivation

An alternate method for passivating galvanized metal is available if the tower cannot be taken offline so that Pre-Q 331 can be added, or if phosphate cannot be used due to discharge limitations. This procedure uses silicate to promote the formation of the passivated layer on the galvanized metal and can be done while the tower is online. We recommend using Pre-QS for this procedure and a separate Technical Bulletin is available that outlines the method.