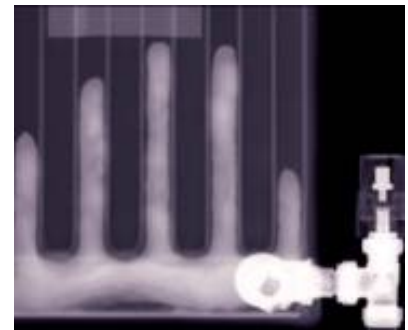


WATER QUALITY IN HYDRONIC SYSTEMS

This paper will provide the reasons why water quality is essential to the extending the longevity, and maintaining the reliability and efficiency of your space heating application. Heating systems in both new construction and existing systems are very often fouled with contaminants that can induce corrosion and poor heat transfer as a result of surface scaling and sludge formation. This scaling and sludge will eventually lead to failure of boilers, heat exchangers, valves, pumps, tanks and piping.

Aluminum is often thought of as unsuitable for hydronic systems because it is more susceptible to damage in poorly maintained systems. Steel systems can operate safely in wider pH range but maintaining the water quality is still beneficial to the life of the system. Proper water quality will maintain the design efficiency of steel, as well as all other materials used for heat exchanging surfaces by inhibiting the formation of scale and sludge. Heat exchangers constructed of aluminum are well suited for use in condensing boiler applications because in properly maintained hydronic loops they are very resistant to corrosion.

In order to establish an environment that is safe for all hydronic systems, routine water treatment is required. Keep in mind that it is not possible to fully clean a system without the application of a chemical cleanser. All metals that are exposed to water will react eventually. This reaction can be controlled and made beneficial to the life of the appliances on the hydronic loop. Once a system is cleaned you have the opportunity to treat the system with additives that will inhibit the formation of contaminants and maintain correct chemistry. Periodic checking is required and if the water chemistry is not to specification corrections must be made.



TYPICAL RADIATOR BUILDUP

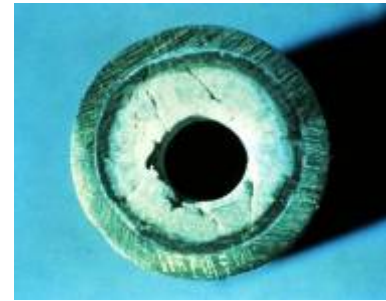
What can cause problems in newly constructed systems?

- Contaminates can take a variety of forms:
- Stamping Oils & Greases
- Metal Swarf—especially copper in a system with aluminum appliances
- Flux Residues—a common source of chloride
- Installation Debris—such as PTFE tape & Fiberglass
- Rust
- Paint chips and associated titanium from paint pigments

The importance of flushing a system until it is completely clean is paramount.

What are the typical problems found in existing hydronic systems?

- Untreated hydronic systems with
- Magnetite
- Lime Scale
- Too high or low a pH value in the system can corrode the appliances on the hydronic loop.



SCALING

Are there other common problems in hydronic systems that can be addressed by hydronic water treatment and maintenance?

Yes, oxygen ingress, the reaction of different metals, corrosion acceleration at higher temperatures, and stress can all cause problems if untreated water is used and not periodically monitored.



UNDER DEPOSIT CORROSION

RETROFITTING A BOILER:

- When you retrofit a new boiler, you may think that this automatically restores the efficiency of the system, but this is not so. If you replace a boiler without cleaning the central heating system, you may see no improvement at all in overall efficiency levels.

If you clean the system using a comprehensive cleaning method and quality water treatment chemicals, however, ***you can restore the existing boiler's efficiency by 2-3% and the effectiveness of the system overall by as much as 15%.*** The key to this is reducing hydraulic imbalance within the system and achieving a greater uniformity of temperature across all heat exchangers in the system.

Once the cleaning process has been completed, an inhibitor is added to provide long-term protection to the entire system. The improvement in system effectiveness as a result of the cleaning process will provide energy savings and increased heating system protection.

BASICS OF ADDING WATER TREATMENT TO YOUR HYDRONIC SYSTEM:

AERCO promotes Sentinel Hydronic System Products. The application of water treatment products must be done according to the manufacturer's instructions to be effective. After the initial application, regularly testing the hydronic water quality is crucial to the proper maintenance and protection all the appliances installed in the system. Sentinel's instruction for the application of their products in both new and existing systems follows.

INSTALLING WATER TREATMENT IN A NEW HYDRONIC SYSTEM:

1. Flush the system
 - Sentinel X300 system flush should be dosed at 1% of the system's water volume.
 - Systems up to 6 months old should be cleaned and flushed with X300
 - The water should be circulated at normal operating temperature for between 1-2 hours with a maximum of 24 hours.
 - If it is not possible to heat the system water, extend the circulation time to a minimum of 24 hours but no longer than one week.
 - X300 actually passivates the metal surfaces in the system, which prevents copper deposits from forming. This is a common cause of pinhole corrosion.
2. Add Sentinel X100 inhibitor
 - Systems should be dosed at 1% of its total water volume.
 - Feeding - If the system is empty, add to any convenient point before filling. If full, use a dosing vessel to inject via the filling loop or other access point.

X300 is a neutral formulation so it is safe for all system metals.

STEPS TO CLEAN AND TREAT AN EXISTING HYDRONIC SYSTEM:

1. Flush the system
 - Sentinel X400 system flush should be dosed at 1% of the system's water volume.
 - Systems older than six months should be cleaned and flushed with X400
 - Sentinel X400 system restorer should be circulated, preferably at normal operating temperature, with all valves open and the pump turned to the maximum allowable system flow for a minimum period of 2 hours or until satisfactory performance is restored.
 - Where systems are badly fouled, a longer period of circulation is recommended, up to four weeks. This product will not clear a completely blocked pipe.
2. Add Sentinel X100 inhibitor
 - Systems should be dosed at 1% of its total water volume.
 - Feeding - If the system is empty, add to any convenient point before filling. If full, use a dosing vessel to inject via the filling loop or other access point.

CONCERNS REGARDING THE USE ON ANTIFREEZE ABOVE 150°F IN ALUMINUM

APPLIANCES:

Aluminum oxide forms a protective coating at relatively neutral pH (6.5 to to 8.5) but dissolves in more alkaline or acidic pH. Uninhibited aqueous mono propylene glycol (MPG) solutions (i.e. with no corrosion inhibitors or additives) have a near-neutral pH whereas some formulations are alkaline with a pH of ~10. As MPG is used or exposed to air it will oxidize and form acidic degradation compounds. Therefore the use of plain MPG might be tolerable for steel or cast iron, but is disastrous when aluminum appliances are present. The use of a phosphate based corrosion inhibitor in some MPG products provides additional protection of steels and cast iron and prevents formation of acidic pH because MPG degradation compounds are neutralized. However phosphate cannot provide full protection of aluminum at an alkaline pH of 10, which is why many manufacturers do not recommend the use of these MPG products with aluminum components above temperatures of 150°F.

Sentinel's X500 antifreeze is formulated with a range of corrosion inhibitors and yields a prevailing neutral pH. X500 is acceptable for application temperatures up to 200°F. There is no need to use the X100 inhibitor when using the X500 product.

The Sentinel X-Series is known for its ability to protect aluminum but it also provides protection for all materials used in closed loop hydronic systems.

For more information on the benefits of proper cleaning and flushing read the technical paper at the following link.

<http://www.aerco.com/PDFs/Products/Accessories/Sentinel-Products/SentinelCaseStudy>