

Application Brief

BOILER SYSTEMS

Industrial facility owners face formidable challenges in managing water treatment programs for boiler and steam systems. The intricacies of water chemistry, coupled with the dynamic and extreme nature of these systems, present a landscape prone to downtime, increased maintenance costs, and safety hazards. Variations in pH, temperature fluctuations, and presence of dissolved solids contribute to the complexity, demanding a meticulous approach to system management.

Integral to many site processes, boilers embody the dichotomy for both efficiency and risk. The conversion of water into steam through the application of heat is not without hazards. Volume increases 1,600 times, generating a force comparable to the explosiveness of gunpowder and highlighting the imperative need for careful treatment.

Your Pain Points

Water, the raw material for steam, brings its own set of challenges. Impurities such as dissolved solids, dissolved gases, and suspended solids can lead to scaling/deposition, corrosion-oxygen attack, caustic corrosion, and boiler water carryover.

Scale or deposition is the buildup of solid material from the reactions between the impurities in water and boiler tube metal. The scale acts as an insulator, diminishing heat transfer efficiency and causing a decrease in boiler efficiency, which can increase fuel usage by up to 5 percent depending on the scale thickness. More severe consequences that can occur in systems that aren't closely monitored include tube overheating and potential equipment failure. Scale forms from salts that have limited solubility in the boiler water. The salts reach the deposit site in a soluble form and precipitate when concentrated by evaporation. Typically, sludge also forms from accumulating solids precipitating in the bulk boiler water or entering the boiler as suspended solids.

Oxygen Attack is one of the most common causes of corrosion inside boilers. Dissolved oxygen in feed water can become very aggressive when heated and reacts with the boiler's internal surface to form corrosive components on the surface of metal. The oxygen attack can further damage steam drums, mud drums, boiler headers, and condensate piping. Water reacts with iron to form magnetite only in the absence of oxygen. The presence of oxygen promotes the formation of Hematite or Red Iron Oxide, which is nonprotective. Oxygen corrosion takes the form of localized deep pitting and can quickly lead to tube failure. Preventing oxygen corrosion requires removing the presence of oxygen.

Acid Attack is a common cause of corrosion that happens when the pH of feed water drops below 8.5. The carbonate alkalinity in the water is converted to carbon dioxide gas (CO_2) by the heat and pressure of the boilers. CO_2 is carried over in the steam. When the steam condenses, CO_2 dissolves in water to form carbonic acid, H_2CO_3 , reducing the pH of condensate returning to the boilers. Acid attack may also impact condensate return piping throughout the facility.

Boiler Water Carryover is the contamination of steam with boiler water solids. High concentrations of soluble or insoluble solids, including oil, alkali, greases, organic matter, and other suspended solids, can stabilize and strengthen the surface of bubbles, encouraging foaming. Steam can carry the foam unintentionally into steam headers through a process called priming, a sudden surge of boiler water caused by a rapid change in load. Priming results in the carryover of boiler water solids into the steam by allowing tiny droplets of water to be released into the steam space. Such carryover causes contamination in the many processes for which steam is used.

Our Comprehensive Solution

Gradient offers a comprehensive approach to address these challenges, integrating advanced chemical treatment with sophisticated feed, monitoring, and control systems. Our tailored programs provide complete deposition and corrosion protection for all boiler applications, ensuring safe, reliable, and efficient steam production.

By combining our application expertise and suite of high performance CURE chemicals, we can tailor the optimal combination to your plant's unique operating needs:

- Oxygen Scavengers — combatting oxygen to prevent corrosion
- Scale Inhibitors — preventing scale buildup for enhanced efficiency and reliability
- Internal Treatments — addressing impurities in boiler water
- Steam-Condensate Line Treatments — ensuring steam purity

Bespoke Service Programs

Gradiant designs customized service programs aligned with each facility’s needs. These include routine water chemistry analyses, chemical inventory checks, system performance monitoring, training, technical support, and on-site response. Chemical dosing systems are integrated as part of the comprehensive chemical and service program.

Benefits

Enhance the longevity of your equipment, boost energy efficiency, and reduce maintenance costs—Gradiant’s tailored solutions redefine the potential of your boiler and steam systems.



UP TO 3X LONGER EQUIPMENT LIFE

Effective chemical solutions can significantly extend the lifespan of water treatment equipment, potentially doubling or tripling its longevity.



UP TO 30% ENERGY EFFICIENCY

Optimized programs improve heat transfer, resulting in reduced energy consumption — savings ranging from 10% to 30% or more.



UP TO 3X LOWER MAINTENANCE COST

Implementing the right treatment program leads to substantial cost savings in maintenance and repair, particularly minimizing unplanned expenses.

Have a question? Contact us at:
[gradiant.com/contact](https://www.gradiant.com/contact)

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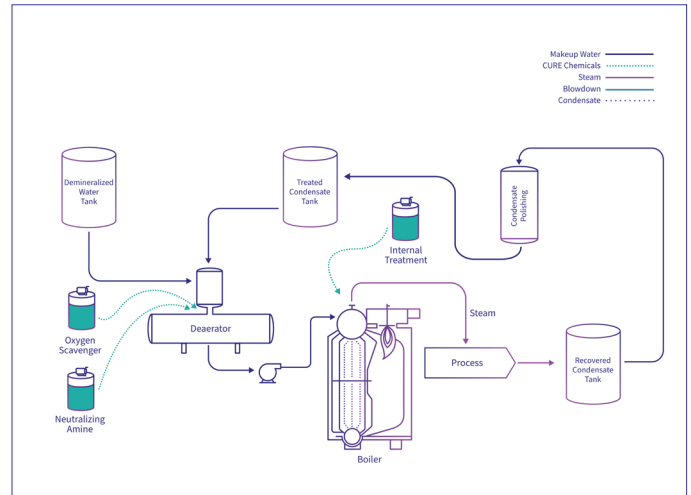


Figure 1: CURE Chemicals in Boiler & Steam Systems

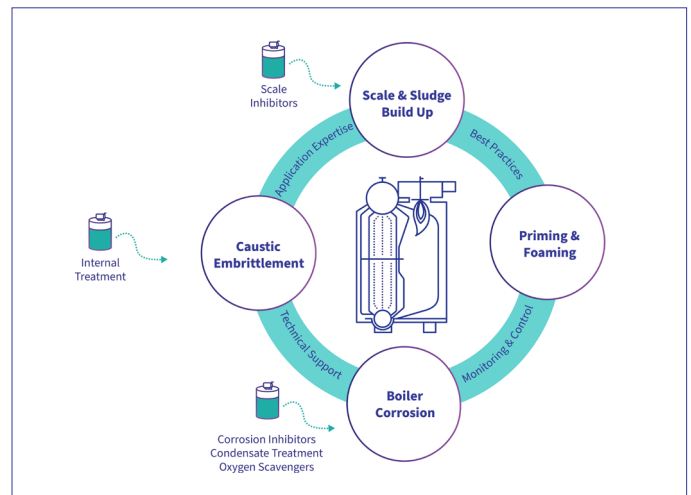


Figure 2: CURE Chemicals Solve Boiler Problems

Learn more about Gradiant’s water treatment expertise across your facility:

- [Technologies](#)
- [Solutions & Industries](#)
- [CURE Chemicals:](#)
 - Water Clarification Systems
 - Membrane Systems
 - Wastewater Treatment
 - Cooling Systems
 - Process Treatment
 - Boiler Systems