Steam Vs. Hot Water Heating Systems and Boilers

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Types of Steam and Hot Water Heating Systems and Boilers

Hot Water Boilers heat water to approximately 200°F, and then circulate the water through a closed loop. Typically, these are simple systems; therefore, they are relatively inexpensive and quite common. In its most basic form, the hot water boiler simply uses a heating source, such as a gas flame, to heat water inside a tank or a series of tubes. The water is then distributed as required.

Low-Pressure Steam Heating Boilers generate steam at approximately 15 psig for distribution through a closed-loop system. These, too, are relatively simple systems used for basic heating needs and are quite common. Capital cost is often relatively low.

High-Temperature Hot Water Boilers typically operate at pressures in the range of 35-350 psig. The pressure must be maintained in order to ensure that the heated water will remain in a liquid form. Nitrogen often is used to keep the system pressurized. For proper performance, the make-up water should be good quality (softened or deionized [DI]). Chemical treatment of the water is important to adjust pH and remove oxygen.

Resistance Boilers use an electric resistance coil to create the heat that is then transferred to the water. Because the heat transfer rate is relatively high, it is important to avoid using chemical treatments that will precipitate hardness. Softened water and/or DI treatment of feed-water is recommended.

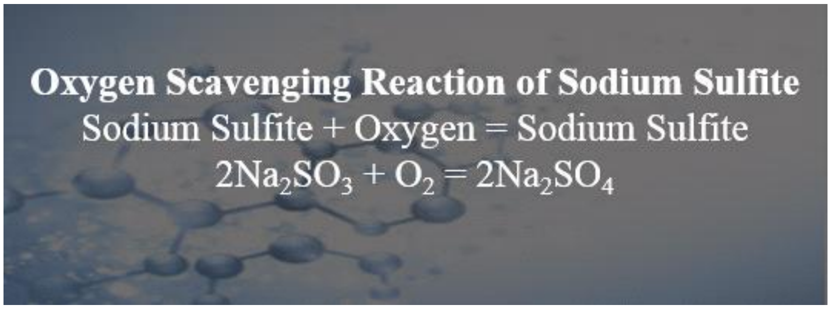
Electrode Boilers may have either water jet or submerged electrodes that are used to convert electricity to heat in order to heat the incoming feed-water. Systems are available in both high-voltage and low-voltage configurations. All electrode boilers require high-purity feed-water and chemicals should be used to remove oxygen and ensure proper pH levels. It is important to ensure that water treatment chemicals used in electrode boilers is appropriate for use with the materials, such as copper alloys, that can be built into those systems.

Feed-Water Heaters extract heat from exhaust steam or boiler blow-down to preheat the incoming feed-water for a boiler. They are used to improve the efficiency of a boiler by recovering some of the heat that would otherwise be lost from exhaust steam or boiler blow-down. Depending on where they are in the process, feed-water heaters can be either high or low pressure.

Corrosion Concerns for Boilers Systems
The main causes of corrosion in these systems are dissolved gases in the feed-water; improper pH of the feed-water; and/or particulate contamination. Of those three causes, *dissolved gases* is generally regarded as the most critical. According to the Boiler Burner Consortium, "The importance of eliminating oxygen as a source of pitting and iron deposition cannot be over emphasized." The Consortium also states that, "Even small concentrations of this gas can cause serious corrosion problems."

The Consensus for Industrial Boilers, published by the ASME, suggests that the maximum level of contaminants for feed-water for a 900 psig boiler should be: <7ppb of oxygen, <20ppb of iron, and <15ppb of copper and the pH should be kept between 8.5 and 9.5.

Oxygen Control
The oxygen scavenger most commonly used in boiler systems is sodium sulfite. The primary factors to consider when selecting an oxygen scavenger are reaction speed, residence time, and operating temperature and pressure as well as the pH of the feed-water. Injection points for the scavenger are typically the deaerator storage system or the feed-water storage tank.



Theoretically, it takes approximately 8 ppm of sodium sulfite to remove 1.0 ppm of dissolved oxygen. In reality, due to various loss factors it is recommended to use approximately 10 lb of sodium sulfite per pound of oxygen. For maximum effectiveness, it is also recommended that the Sodium sulfite be fed continuously through the use of a chemical pump.

It is important to note that as water temperature increases, the reaction time of the sodium sulfite will increase. At temperatures of 212°F and above, the reaction is very fast. Increasing the feed of sodium sulfite will also increase the reaction speed. Reaction time will also be affected by the pH of the water, the ideal pH range being 8.5-10.0.

Monitoring is Important
It is extremely important to implement a corrosion control monitoring program that includes the following tasks.

- Comparing of test results to acceptable limits
- An action plan, in case test results are not within acceptable limits
- A plan to modify treatment in case test results demonstrate a need for improvement

Specific Tests
- Sodium sulfite (if sulfite is used)
- Phosphate level (if phosphates are used)
- pH level
- Conductivity