OSORNO

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## Boiler Water

Boilers are widely used for applications that include water heating, central heating, boiler-based power generation, cooking, and sanitation. The term “boiler” is used even though the fluid does not necessarily boil. In North America the term "furnace" is normally used if the purpose is not actually to boil the fluid. The facts outlined in this newsletter apply regardless of whether the term “boiler” or “furnace” is used.

Boiler feedwater, as well as the water circulating in a boiler system (“boiler water”) provide a distinct set of water treatment challenges. The main challenges, even in low-pressure systems, are corrosion and scale build-up (“fouling”). Both can result in serious damage, and ultimately lead to boiler failure. Many problems can result from the use of untreated feedwater in boilers, including: lower heat transfer efficiency, overheating, damage, and high cleaning costs.

This article focuses on low-pressure boiler systems – the most frequently used boiler type – and provides information on solutions to maximize boiler performance with minimal risk.

### Feedwater

Boiler feedwater should contain low calcium and magnesium levels which cause scaling. Scaling can be mediated by using an anti-scalant. The amount of anti-scalant required is proportional to the calcium concentration of the boiler feedwater. It is ideal to use water purified by reverse osmosis (RO water), however, additives such as oxygen scavenger will still be required.

### Corrosion

There are several factors that contribute to boiler corrosion, oxygen being the most important one. One does not need to explain that iron plus moisture results in rust when oxygen is present. Because rust is porous, this process will continue until the sheet metal is rusted through. Excluding oxygen is an obvious way to mitigate corrosion. Low water pH can also contribute to corrosion.

A simple rule in boiler operations is that oxygen must never be present. After all, corrosion is an oxidation process. Large-scale operations, especially for high-pressure (steam) systems, use special de-aerators for feedwater, in addition to oxygen scavengers that continually circulate in water and steam.

The easiest way to avoid steel corrosion is by increasing the pH of boiler water. This works even if oxygen is present. Adjusting boiler water to a range of pH 9.0 – 9.5, (preferably 9.2 – 9.4) will minimize corrosion. Some owners of all-steel boiler systems prefer to operate at a pH of 10 or higher. These high pH values should be left to specialists, because steel can

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develop a condition that is known as “caustic embrittlement” under these conditions.

Unfortunately, other materials through which the boiler water circulates, may have different pH requirements. For example, copper and its alloys (brass, bronze) are sensitive to ammonia and amines that are commonly used in additives for boiler water, but only at elevated pH and only in the presence of oxygen. The obvious choice is to protect copper, brass, and bronze components through the exclusion of oxygen in boiler water.

A different problem arises when aluminium and its alloys are used in boiler systems. It is important that only special aluminium alloys are used; un-alloyed aluminium is particularly sensitive to corrosion – even ordinary table salt can corrode pure aluminium quickly. Aluminium and its alloys are sensitive to high and low pH. This conflict between the pH requirements of steel and aluminium requires a compromise: operating a boiler in the vicinity of pH 8.5.

## Boiler Water Testing

Simple tests should be done on a regular (weekly) basis to determine whether boiler water treatment is required with speciality chemicals:

**1. Test pH:** Ideally, the boiler water should be moderately alkaline (pH 9.0 – 9.5 for steel boilers, about 8.5 for systems with aluminium heaters). An inexpensive pH tester can be purchased through Osorno.

**2. Test ORP:** The oxidation-reduction potential (ORP) should be negative (-100 mV or lower), indicating a reducing environment. An inexpensive ORP tester can be purchased through Osorno.

**3. Test Calcium Concentration.** Osorno can measure the calcium concentration to determine the need for anti-scalants, free of charge for clients.

## Boiler Water Additives

Typical additives for boiler feedwater are anti-scalant, oxygen scavenger, and pH booster.

**Oxygen Scavengers:** Oxygen scavengers are added to boiler water to remove oxygen and prevent corrosion. Oxygen is enemy #1 in boiler water. Osorno’s oxygen scavengers are packaged in returnable 20 litre delcans. One delcan is sufficient to treat 5,000 L of boiler water, and can capture the oxygen content of 1,400 L of air. Oxygen scavengers adjust the pH of boiler water to between 8.5 and 9.0. For boiler systems with aluminium components, oxygen scavenger is available with increased aluminium protection.

**Anti-scalants:** Boiler anti-scalants are widely used to reduce scale formation. Scale build-up can lead to explosive local overheating, and even boiler rupture. Osorno will measure the amount of anti-scalants required for boiler systems free of charge for clients. Osorno’s anti-scalant is packaged in returnable 20 litre delcans.

**pH Boosters:** Osorno’s oxygen scavengers and Osorno’s anti-scalants work best when boiler water pH is 8.5 or greater. In some cases such as all-steel systems, a pH in the range 9.0 to 9.5 or higher, may be desirable. Addition of Osorno's pH booster can achieve the optimum boiler water pH. Osorno’s pH booster is packaged in returnable 4 litre bottles.

***Want more information on how to protect your boiler? Contact Osorno.***

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