# Application Note

## Boiler Blowdown

**Industry: Refining, Food & Beverage, Power, Oil & Gas, Pulp & Paper, Chemical**
**Products: Contacting Conductivity Process Liquid Analyzer**

## Introduction

To defray energy costs, many industrial plants have their own boilers to generate steam to produce a portion of their energy needs. In addition to generating power, the steam may also be used directly in plant processes or indirectly via heat exchangers or steam jacketed vessels.

## Problems

The raw water used to feed the boilers, contains varying levels of impurities that must be removed to protect the boiler and associated equipment. Pretreatment processes such as reverse osmosis, ion exchange, filtration, softening and demineralization may be used to reduce the level of impurities, but even the best pretreatment processes will not remove them all and will continuously carry some dissolved mineral impurities into the boiler.

These dissolved impurities accumulate in the boiler water when steam is made; only pure water leaves the boiler. The increasing concentration of *dissolved solids* leads to *carryover* of boiler water into the steam, damaging piping, steam traps and other process equipment. The concentration of *dissolved solids* increases until the boiler water can no longer hold all of them in solution and a saturation point is reached. They then begin to drop out (*suspended solids*) forming a sludge or scale on the boiler walls and piping.

Boiler problems are avoided by periodically discharging or "blowing down" water from the boiler to reduce the concentrations of *suspended* and *total dissolved solids*. Surface water blowdown is often done continuously to reduce the level of *dissolved solids*, and bottom blowdown is performed periodically to remove sludge *(suspended solids*) from the bottom of the boiler. The frequency and level of blowdown required each day depends upon the concentration of impurities and the rate at which they build up in the boiler water.

Boilers operating on soft water will require more top or skimmer blowdown to remove dissolved solids whereas boilers operating on hard water will require more bottom blowdown to remove the settled solids.

While control of suspended and dissolved solids in the boiler is critical, care must be taken to avoid excessive blowdown, as this would increase the demand for make-up (feed) water, treatment chemicals, and fuel.

## Benefits/Solutions

The benefits for proper boiler blowdown control include the following:

- Reduced operating costs (less feedwater consumption; chemical treatment and higher heating efficiency)
- Reduced maintenance and repair costs (minimized carryover and deposits)
- Cleaner and more efficient steam
- Minimized energy loss from boiler blowdown can save about 2% of a facility's total energy use with an average simple payback of less than one year.

The most common methodologies used for boiler blowdown control include: (1) continuous, (2) manual and (3) automatic.

Continuous blowdown utilizes a calibrated valve and a blowdown tap near the boiler water surface. As the name implies, it continuously takes water from the top of the boiler at a predetermined rate to reduce the level of dissolved solids. The rate is usually set slightly greater than necessary to be on the safe side.

Manual blowdown is accomplished at most plants by taking boiler water samples once a shift and adjusting the blowdown accordingly. This grab sample approach means that operators cannot immediately respond to changes in feedwater conditions or variations in steam demand and scaling conditions can occur and go undetected until the next sample check.

Automatic blowdown control is achieved by constantly monitoring the conductivity value of the boiler water and adjusting the blowdown rate and duration based on a specific conductivity set point. This provides control of the water chemistry regardless of the boiler load conditions. Actual operation data verifies that automatic control can maintain boiler water conductivity consistently within 5% of the set point.

Manual blowdown control cannot maintain this level of control more than 20% of the time.

Upgrading from manual blowdown control to automatic control can reduce a boiler's energy use by 2 – 5 percent and blowdown water losses by up to 20 percent.

Feed water usually contains one limiting component such as chloride, sulfate, carbonate, or silica. Even if the component is not conductive, for example silica, its concentration is usually proportional to a component that can be measured by conductivity; therefore, conductivity is a viable measurement for monitoring the overall total dissolved solids present in the boiler. A rise in conductivity indicates a rise in the "contamination" of the boiler water.

## Summary/Tangible Benefit

The frequency and duration required for boiler blowdown is significantly affected by the water quality. Improving feedwater quality through make-up water, chemical treatment and proper blowdown control can significantly reduce treatment and operational costs including:

- Reduced operating costs
- Reduced maintenance and repair costs
- Cleaner and more efficient steam
- Energy Savings

Increased efficiency and reduced operating costs can be achieved by using the Yokogawa Conductivity Series line of products. Control configurations will carry with the application and the customer's requirements.

## Product Recommendations

**Conductivity Measurement System:**

***Process Liquid Analyzer:***

- 2-wire FLEXA Contacting Conductivity Analyzer
- 4-wire SC450G Contacting Conductivity Analyzer



***Sensor Selection:***

**Option #1:**

SC42-SP34 Large-Bore Conductivity Sensor (fittings available for  Flow-Thru, Insertion, or Immersion installations)

**Option #2:**

SC4A Conductivity Sensor (fittings available for Insertion, Sanitary, or Retractable installations.)

***Another alternative would be Toroidal or Inductive Conductivity:***

***Process Liquid Analyzer:***

- 2-wire FLEXA Inductive Conductivity Analyzer
- 4-wire ISC450G Inductive Conductivity Analyzer

***Sensor Selection:***

ISC40 Inductive Conductivity Sensor (fittings available for  Flow-Thru, Insertion, or Immersion installations)

**Note:** For additional information on this application contact the local Yokogawa Process Liquid Analyzer Department