Application Note

THORNTON
Leading Pure Water Analytics

Industrial Boiler Blowdown Control
Using Conductivity

Application Note AN-0119

Background

In boiler operation, the evaporation of steam leaves behind an increasing concentration of minerals in the water that become corrosive and/or scale producing. Corrosion leads to boiler tube failures, down time and very expensive repairs. Scaling of heat transfer surfaces decreases thermal efficiency and causes underdeposit corrosion. Shutdown for cleaning and boiler tube maintenance may become necessary. All of these consequences are difficult to deal with and costly to correct.

Blowdown removes a portion of the boiler water containing concentrated minerals and allows make-up with more dilute softened or demineralized water. In this way, the concentration of minerals can be controlled within an acceptable range. Along with proper chemical treatment for pH, dissolved oxygen and scale inhibitor, well controlled boiler blowdown can greatly extend the life and efficiency of the boiler. At the same time, the significant energy losses and chemical waste of excessive blowdown can be avoided.

Boiler Conductivity Measurement

Conductivity, sometimes expressed as ppm TDS (parts per million total dissolved solids), is the method used to monitor mineral concentration. Many industrial boilers use periodic grab sample conductivity measurements and manual setting of the blowdown rate. This results in large swings in mineral content between grab sample measurements caused by changes in boiler load, make up water quality, etc. that can cause periods of scaling, corrosion or excessive blowdown.

A much improved strategy uses a continuous on-line conductivity measurement and automatic blowdown control to maintain consistent mineral concentration and minimize corrosion and scaling under all conditions.* The THORNTON Boiler Conductivity Sensor with its high temperature/pressure rating allows continuous measurement directly in the blowdown line without the expense of a sample cooler or cooling water flow for samples up to 250 psig (17 bar) at 392 °F (200 °C).

The Boiler Sensor combined with a THORNTON M300 or 770MAX transmitter with selection of internal control options, provide a continuous, accurate conductivity measurement with readout in µS/cm, mS/cm or ppm TDS. The transmitter can be located up to 200 ft (61 m) away from the sensor and retransmit alarm, control and/or analog signals even further. Automatic blowdown control with a THORNTON system allows close management of boiler water quality and can reduce total blowdown, saving a significant amount of energy.

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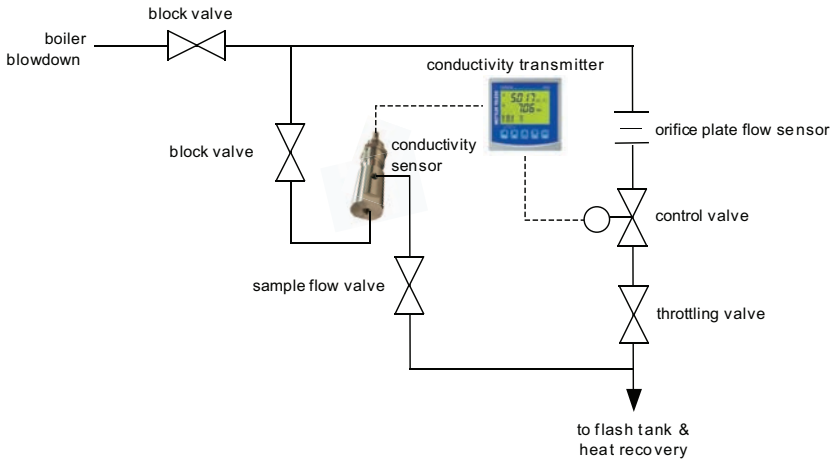
For low pressure boilers, the conductivity sensor can be located directly in the blowdown line or in a bypass line taken from it. For higher pressure boilers, the sample must first be cooled. For a valid measurement, the pressure must be dropped at a location that will assure that the conductivity sensor is always immersed in the water phase with no steam present. Although the sample may be very hot, the temperature compensation of the conductivity sensor and transmitter provide measurement referenced to 77 °F (25 °C) in accordance with water treatment guidelines.

Shown below is a typical installation of conductivity equipment to continuously monitor a boiler blowdown sample. If the pressure/temperature is greater than 250 psig/392 °F (17 bar/200 °C) then a sample cooler is needed ahead of the conductivity sensor. The sample flow provides a small continuous blowdown. Conductivity can be used to control the main blowdown with various degrees of sophistication:

1. The simplest control is done manually, by adjusting the hand throttling valve based on the conductivity reading. This would be without a control valve
2. Automatic on-off control uses a setpoint and relay in the conductivity transmitter to open and close a solenoid control valve. The throttling valve could be used to limit the flow when the solenoid valve is open.
3. Automatic proportional control uses a setpoint and PID (proportional, integral, derivative) control in the conductivity transmitter to modulate a proportional control valve. In this case the throttling valve would not be needed. Alternatively, PID control could cycle a solenoid valve with proportional timing.



* It should be noted that direct conductivity measurement is different from "neutralized conductivity." Neutralized conductivity is measured on a grab sample to which weak acid has been added to eliminate the effects of alkalinity. It typically gives lower results than direct conductivity, whether by grab sample or continuous measurement. Treatment chemical suppliers can provide information on the relationship.

Mettler-Toledo Thornton Conductivity Equipment for Boiler Blowdown Control

M300 Conductivity Transmitter, available with one or two sensor channels (includes on-off and PID control capabilities)

58 031 264 Boiler water conductivity sensor
58 084 016 Conductivity sensor flow housing
58 080 20X VP Cable

alternative:

770MAX Multiparameter Transmitter with 4 channels (includes on-off control capability)
58 031 038 Boiler water conductivity sensor
58 084 016 Conductivity sensor flow housing
1XXXX-79 Patch cable

Either of these measurement options can also provide continuous pH and dissolved oxygen measurements on a cooled sample with the addition of appropriate Mettler-Toledo Thornton sensors.

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Visit for more information

Mettler-Toledo Thornton, Inc.
36 Middlesex Turnpike,
Bedford, MA 01730 USA
Tel. +1-781-301-8600,
Fax +1-781-301-8701
Toll Free +1-800-510-PURE (US and Canada only)
thornton.info@mt.com

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