Boiler Blowdown

FACT SHEET

Even with the best pretreatment programs, boiler feedwater often contains some degree of impurities, such as suspended and dissolved solids. The impurities can remain and accumulate inside the boiler as the boiler operation continues. The increasing concentration of dissolved solids may lead to carryover of boiler water into the steam, causing damage to piping, steam traps and even process equipment. The increasing concentration of suspended solids can form sludge, which impairs boiler efficiency and heat transfer capability.

To avoid boiler problems, water must be periodically discharged or "blown down" from the boiler to control the concentrations of suspended and total dissolved solids in the boiler. Surface water blowdown is often done continuously to reduce the level of dissolved solids, and bottom blowdown is performed periodically to remove sludge from the bottom of the boiler.

The importance of boiler blowdown is often overlooked. Improper blowdown can cause increased fuel consumption, additional chemical treatment requirements, and heat loss. In addition, the blowdown water has the same temperature and pressure as the boiler water. This blowdown heat can be recovered and reused in the boiler operations.

Boiler Blowdown Benefits

- Less water, fuel and treatment chemicals needed;
- Less maintenance and repair cost (minimized carryover and deposits);
- Saves manual supervision for other tasks (with automatic control);
- Cleaner and more efficient steam;
- Reduced operating cost (reduction in consumption, disposal, treatment and heating of water);
- Minimized energy loss from boiler blowdown can save about 2 percent of a facility's total energy use with an average simple payback of less than one year.

Best Operating Practices for Boiler Blowdown

As mentioned earlier, insufficient blowdown may cause carryover of boiler water into the steam or the formation of deposits on boiler tubes. Excessive blowdown wastes energy, water and treatment chemicals. The blowdown amount required is a function of boiler type, steam pressure, chemical treatment program, and feedwater quality. The optimum blowdown amount is typically calculated and controlled by measuring the conductivity of the boiler feedwater. Conductivity is a viable indicator of the overall total dissolved solid concentrations. Typically, blowdown rates range from 4 – 8 percent of boiler feedwater flow rate, but can be as high as 20 percent with extremely poor quality feedwater.

A commonly used ratio for the amount of boiler blowdown required is computed as follows:

$$\text{Required Blowdown} = \frac{C_{\text{feedwater}}}{C_{\text{blowdown}}}$$

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where $C_{feedwater}$ = the measured concentration of the selected chemical in the feedwater

$C_{blowdown}$ = the measured concentration of the same chemical in the blowdown

The maximum recommended concentration limits according to the American Boiler Manufacturers Association (ABMA) is listed in the table below.

ABMA Recommended Feedwater Chemistry Limits

Boiler Operating Pressure (psig)	Total Dissolved Solids (ppm)	Total Alkalinity (ppm)	Total Suspended Solids (ppm)
0 - 50	2,500	500	
51 - 300	3,500	700	15
301 - 450	3,000	600	10
451 - 600	2,500	500	8
601 - 750	1,000	200	3
751 - 900	750	150	2
901 – 1,000	625	125	1

The American Society of Mechanical Engineers (ASME) has developed a best operating practices manual for boiler blowdown. The recommended practices are described in Sections VI and VII of the ASME *Boiler and Pressure Vessel Code*. You can identify energy-saving opportunities by comparing your blowdown and makeup water treatment practices with the ASME practices. The ASME *Boiler and Pressure Vessel Code* can be ordered through the ASME Web site at http://www.asme.org/bpvc/.

Automatic Blowdown Controls

There are two types of boiler blowdowns: manual and automatic. Plants using manual blowdown must check samples many times a day or according to a set schedule, and adjust blowdown accordingly. With manual boiler blowdown control, operators are delayed in knowing when to conduct blowdown or for how long. They cannot immediately respond to the changes in feedwater conditions or variations in steam demand.

An automatic blowdown control constantly monitors boiler water conductivity and adjusts the blowdown rate accordingly to maintain the desired water chemistry. A probe measures the conductivity and provides feedback to the controller driving a modulating blowdown valve. An automatic blowdown control can keep the blowdown rate uniformly close to the maximum allowable dissolved solids level, while minimizing blowdown and reducing energy losses.

Purchasing and installing an automatic blowdown control system can cost from $2,500 to $6,000 with a mostly 1- to 3-year payback period on the investment. A complete system should consist of a low- or high-pressure conductivity probe, temperature compensation and signal condition equipment, and a blowdown-modulating valve.

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

Blowdown Heat Recovery Units

In addition to proper blowdown practices, including the use of automatic blowdown control, reducing cost and heat loss associated with boiler blowdown can also be achieved through recovering the heat/energy in the blowdown. The

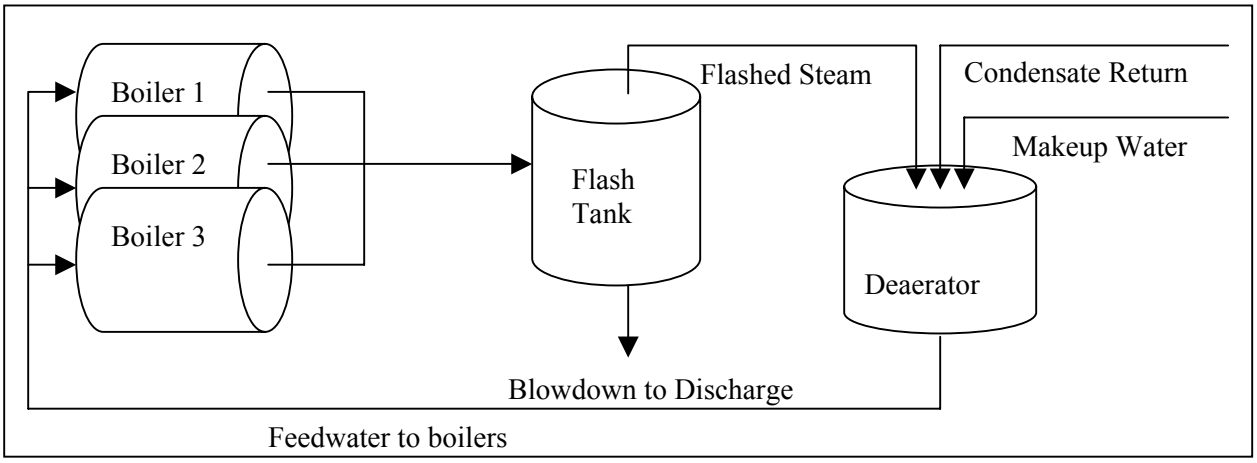
blowdown water has the same temperature and pressure as the boiler water. Before this high-energy waste is discharged, the resident heat in blowdown can be recovered with a flash tank, a heat exchanger, or the combination of the two. Any boiler with continuous surface water blowdown exceeding 5 percent of the steam generation rate is a good candidate for blowdown waste heat recovery. A boiler blowdown heat recovery project at Augusta Newsprint Mill saved the company $31,000 in fuel costs and 14,000 MMBtu in energy annually.

To learn how to calculate your energy recovery potential, please see the fact sheets on Boiler Blowdown Energy Recovery (http://www.oit.doe.gov/bestpractices/energymatters/wint2003_boiler.shtml) and Recover Heat from Boiler Blowdown (http://www.energystar.gov/ia/business/industry/heat_recovery.pdf).

Flash Tank System

The flash tank system shown in the figure below can be used when expense and complexity must be reduced to a minimum. In this system, the blowdowns from the boilers are sent through a flash tank, where they are converted into low-pressure steam. This low-pressure steam is most typically used in deaerators or makeup water heaters.

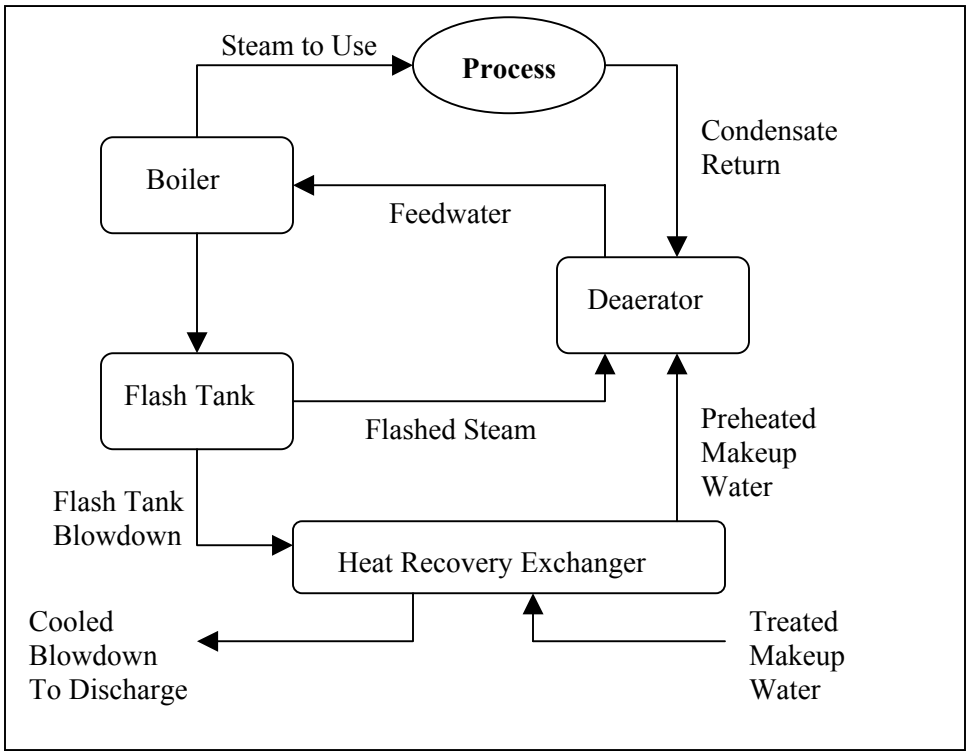
Schematics of a Flash Tank System



Flash Tank – Heat Exchanger System

The system shown below consists of a flash tank and a heat exchanger. The temperature of the blowdown leaving the flash tank is usually still above 220°F. The heat of this flash blowdown can be used to heat makeup water by sending it through the heat exchanger, while cooling the blowdown at the same time. Heating boiler makeup water saves on fuel costs. An additional advantage of cooling blowdown is in helping to comply with local codes regulating the discharge of high temperature liquids into the sewer system.

Schematics of a Flash Tank – Heat Exchanger System



Blowdown Wastewater Permitting

For information on boiler blowdown wastewater general permitting (in North Carolina), please visit the website for NC Division of Water Quality at http://h2o.enr.state.nc.us/su/Forms_Documents.htm.

Conclusion

As mentioned above, the blowdown amount required can be significantly affected by the feedwater quality. Therefore, improving feedwater quality through makeup water treatment and chemical treatment in the boiler system can reduce blowdown rate. For more information on chemical treatments, please see Boiler Chemical 101 (http://www.p2pays.org/ref/32/31321.pdf).

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