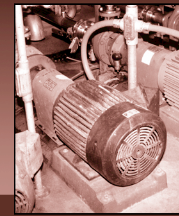
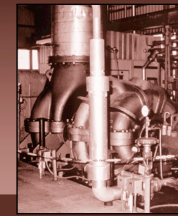
Energy Tips

Steam



Motors



Compressed Air

Minimize Boiler Blowdown

Minimizing your blowdown rate can substantially reduce energy losses, as the temperature of the blown-down liquid is the same as that of the steam generated in the boiler. Minimizing blowdown will also reduce makeup water and chemical treatment costs.

As water evaporates in the boiler steam drum, solids present in the feedwater are left behind. The suspended solids form sludge or sediments in the boiler, which degrades heat transfer. Dissolved solids promote foaming and carryover of boiler water into the steam. To reduce the levels of suspended and total dissolved solids (TDS) to acceptable limits, water is periodically discharged or blown down from the boiler. Mud or bottom blowdown is usually a manual procedure done for a few seconds on intervals of several hours. It is designed to remove suspended solids that settle out of the boiler water and form a heavy sludge. Surface or skimming blowdown is designed to remove the dissolved solids that concentrate near the liquid surface. Surface blowdown is often a continuous process.

Insufficient blowdown may lead to carryover of boiler water into the steam, or the formation of deposits. Excessive blowdown will waste energy, water, and chemicals. The optimum blowdown rate is determined by various factors including the boiler type, operating pressure, water treatment, and quality of makeup water. Blowdown rates typically range from 4% to 8% of boiler feedwater flow rate, but can be as high as 10% when makeup water has a high solids content.

Example

Assume that the installation of an automatic blowdown control system (see sidebar) reduces your blowdown rate from 8% to 6%. This example assumes a continuously operating natural-gas-fired, 150-psig, 100,000-pound-per-hour steam boiler. Assume a makeup water temperature of 60°F, boiler efficiency of 82%, with fuel valued at \$3.00 per million Btu (MBtu), and the total water, sewage and treatment costs at \$0.004 per gallon. Calculate the total annual cost savings.

$$\text{Boiler Feedwater:}\quad \text{Initial} = \frac{100{,}000}{(1 - 0.08)} = 108{,}695 \text{ lbs/hr}$$

$$\text{Final} = \frac{100{,}000}{(1 - 0.06)} = 106{,}383 \text{ lbs/hr}$$

Makeup Water Savings = 108,695 – 106,383 = 2312 lbs/hr
Enthalpy of boiler water = 338.5 Btu/lb; for makeup water at 60°F = 28 Btu/lb
Thermal Energy Savings = 338.5 – 28 = 310.5 Btu/lb

$$\textbf{Annual Fuel Savings} = \frac{2312 \text{ lbs/hr x } 8760 \text{ hrs/yr x } 310.5 \text{ Btu/lb x } \$3.00\text{/MBtu}}{0.82 \text{ x } 106} = \mathbf{\$23{,}007}$$

$$\textbf{Annual Water and Chemical Savings} = \frac{2312 \text{ lbs/hr x } 8760 \text{ hrs/yr x} \$0.004\text{/gal}}{8.34 \text{ lbs/gal}} = \mathbf{\$9{,}714}$$

Annual Cost Savings = \$23,007 + \$9,714 **= \$32,721**

Automatic Blowdown Control Systems

These systems optimize surface blowdown by regulating water volume discharged in relation to amount of dissolved solids present. Conductivity, TDS, silica or chlorides concentrations, and/or alkalinity are reliable indicators of salts and other contaminants dissolved in boiler water. A probe provides feedback to a controller driving a modulating blowdown valve. An alternative is proportional control —with blowdown rate set proportional to makeup water flow.

Cycles of Concentration

"Cycles of concentration" refers to the accumulation of impurities in the boiler water. If the boiler water contains ten times the level of impurities in the makeup water, it is said to have ten cycles of concentration.

Adapted from an Energy TIPS fact sheet that was originally published by the Industrial Energy Extension Service of Georgia Tech. For additional information on steam system efficiency measures, contact the OIT Clearinghouse at (800) 862-2086.

Suggested Actions

Review your blowdown practices to identify energy saving opportunities. Examine operating practices for boiler feedwater and blowdown rates developed by the American Society of Mechanical Engineers (ASME). Considerations include operating pressure, steam purity, and deposition control. Consider an automatic blowdown control system (see sidebar).

References and Footnotes

1. "Consensus Operating Practices for Control of Feedwater/Boiler Water Chemistry in Modern Industrial Boilers", published by the ASME, 1994.
2. "Recommended Rules for the Care and Operation of Heating Boilers", Section VI of the ASME Boiler and Pressure Vessel Code, 1995.
3. "Recommended Guidelines for the Care of Power Boilers", Section VII of the ASME Boiler and Pressure Vessel Code, 1995.

About DOE's Office of Industrial Technologies

The Office of Industrial Technologies (OIT), through partnerships with industry, government, and non-governmental organizations, develops and delivers advanced energy efficiency, renewable energy, and pollution prevention technologies for industrial applications. OIT is part of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy.

OIT encourages industry-wide efforts to boost resource productivity through a strategy called Industries of the Future (IOF). IOF focuses on the following nine energy- and resource-intensive industries:

- Agriculture
- Aluminum
- Chemicals
- Forest Products
- Glass
- Metal Casting
- Mining
- Petroleum
- Steel

OIT and its BestPractices program offer a wide variety of resources to industrial partners that cover motor, steam, compressed air, and process heating systems. For example, BestPractices software can help you decide whether to replace or rewind motors (MotorMaster+), assess the efficiency of pumping systems (PSAT), or determine optimal insulation thickness for pipes and pressure vessels (3E Plus). Training is available to help you or your staff learn how to use these software programs and learn more about industrial systems. Workshops are held around the country on topics such as "Capturing the Value of Steam Efficiency," "Fundamentals and Advanced Management of Compressed Air Systems," and "Motor System Management." Available technical publications range from case studies and tip sheets to sourcebooks and market assessments. The *Energy Matters* newsletter, for example, provides timely articles and information on comprehensive energy systems for industry. You can access these resources and more by visiting the BestPractices Web site at **www.oit.doe.gov/bestpractices** or by contacting the OIT Clearinghouse at **800-862-2086** or via email at **clearinghouse@ee.doe.gov.**

BestPractices is part of the Office of Industrial Technologies' (OIT's) Industries of the Future strategy, which helps the country's most energy-intensive industries improve their competitiveness. BestPractices brings together the best-available and emerging technologies and practices to help companies begin improving energy efficiency, environmental performance, and productivity right now.

BestPractices focuses on plant systems, where significant efficiency improvements and savings can be achieved. Industry gains easy access to near-term and long-term solutions for improving the performance of motor, steam, compressed air, and process heating systems. In addition, the Industrial Assessment Centers provide comprehensive industrial energy evaluations to small and medium-size manufacturers.

FOR ADDITIONAL INFORMATION, PLEASE CONTACT:

Theo Johnson
Office of Industrial Technologies
Phone: (202) 586-6937
Fax: (202) 586-6507
Theodore.Johnson@hq.doe.gov
www.oit.doe.gov/bestpractices

OIT Clearinghouse
Phone: (800) 862-2086
Fax: (360) 586-8303
clearinghouse@ee.doe.gov

Please send any comments, questions, or suggestions to webmaster.oit@ee.doe.gov

Visit our home page at www.oit.doe.gov

Office of Industrial Technologies
Energy Efficiency
and Renewable Energy
U.S. Department of Energy
Washington, DC 20585-0121

DOE/GO-10099-954
Revised June 2001
Steam Tip Sheet #9