Monitor Flue Gas Temperature

An indirect indicator of scale or deposit formation is flue gas temperature. If the flue gas temperature rises (with boiler load and excess air held constant), the effect is possibly due to the presence of scale.

Perform Visual Inspections

Visually inspect boiler tubes when the unit is shut down for maintenance. Scale removal can be achieved by mechanical means, or acid cleaning. If scale is present, consult with your local water treatment specialist and consider modifying your feedwater treatment or chemical additives schedule.

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

Clean Boiler Water-side Heat Transfer Surfaces

Even on small boilers, the prevention of scale formation can produce substantial energy savings. Scale deposits occur when calcium, magnesium, and silica, commonly found in most water supplies, react to form a continuous layer of material on the waterside of the boiler heat exchange tubes.

Scale creates a problem because it typically possesses a thermal conductivity an order of magnitude less than the corresponding value for bare steel. Even thin layers of scale serve as an effective insulator and retard heat transfer. The result is overheating of boiler tube metal, tube failures, and loss of energy efficiency. Fuel wastage due to boiler scale may be 2% for water-tube boilers and up to 5% in fire-tube boilers. Energy losses as a function of scale thickness and composition are given in the table below.

Energy Loss Due to Scale Deposits*

Scale Thickness, inches	Fuel Loss, % of Total Use		
	Scale Type		
	"Normal"	High Iron	Iron plus Silica
1/64	1.0	1.6	3.5
1/32	2.0	3.1	7.0
3/64	3.0	4.7	–
1/16	3.9	6.2	–

Note: "Normal" scale is usually encountered in low-pressure applications. The high iron and iron plus silica scale composition results from high-pressure service conditions.
*Extracted from National Institute of Standards and Technology, Handbook 115, Supplement 1.

Example

A boiler annually uses 450,000 million Btus (MBtu) of fuel while operating for 8000 hours at its rated capacity of 45,000 pounds-per-hour (lbs / hr) of 150-psig steam. If scale 1 / 32nd of an inch thick is allowed to form on the boiler tubes, and the scale is of "normal" composition, the table indicates a fuel loss of 2%. The increase in operating costs, assuming energy is priced at $3.00 / MBtu, is:

Annual Operating Cost Increase = 450,000 MBtu / year x $3.00 / MBtu x 0.02
= $27,000

Suggested Actions

Any scale in a boiler is undesirable. The best way to deal with scale is not to let it form in the first place. Scale formation is prevented by:

- pretreatment of boiler makeup water (using water softeners, demineralizers, and reverse osmosis to remove scale-forming minerals),
- chemical injection into the boiler feedwater, and
- adopting proper boiler blowdown practices.

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	Chemicals	Glass	Mining	Steel
Aluminum	Forest Products	Metal Casting	Petroleum	

To help industries begin to save energy, reduce costs, and cut pollution right away, OIT offers a comprehensive portfolio of emerging technology, practices, tools, information, and resources in a variety of application areas, such as motor systems, steam systems, compressed air systems, and combined heat and power systems. Likewise, OIT's Industrial Assessment Centers (IAC), located throughout the U.S., offer energy, waste, and productivity assessments to small and medium-sized manufacturers. Users can take advantage of the abundant resources, such as software, fact sheets, training materials, etc. available from OIT.

Motor Systems — helps industry increase productivity and reliability through energy-efficient electric motor-driven systems.

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- ☐ Buying an Energy-Efficient Electric Motor
- ☐ Optimizing Your Motor-Driven System
- ☐ Frequently Asked Questions on: The Impacts of the Energy Policy Act of 1992 on Industrial End Users of Electric Motor-Driven Systems
- ☐ Energy Management for Motor Driven Systems
- ☐ Improving Pumping System Performance: A Sourcebook for Industry

Software –

- ☐ MotorMaster+ 3.0 and training CD
- ☐ ASDMaster
- ☐ Pumping System Assessment Tool

Training –

- ☐ MotorMaster+ 3.0 Software
- ☐ Adjustable Speed Drive Application
- ☐ Pumping System Optimization
- ☐ Pumping System Assessment Tool

Access the Web site at ***www.motor.doe.gov***.

Steam Systems — helps industry enhance productivity, increase profits, and reduce emissions through better steam system management.

Documents –

- ☐ Energy Efficiency Handbook
- ☐ Plant Services Article - *The Steam Challenge*
- ☐ Energy Manager Article - *Steaming Ahead*
- ☐ Oak Ridge National Laboratory's Insulation Guidelines
- ☐ 1998 IETC Steam Session Papers

Case Studies –

- ☐ Georgia Pacific Achieves 6-Month Payback
- ☐ Bethlehem Steel Showcase Demonstration

Software –

- ☐ 3EPlus Software for Determining Optimal Insulation Thickness

Access the Web site at ***www.oit.doe.gov/steam***.

Compressed Air Systems — dedicated to improving the efficiency and performance of industrial compressed air systems.

Documents –

- ☐ Improving Compressed Air System Performance: A Sourcebook for Industry

Training –

- ☐ Fundamentals of Compressed Air Systems (For schedule and location, call (800) 862-2086)

Access the Web site at ***www.knowpressure.org***.

Industrial Assessment Centers — enable small and medium-sized manufacturers to have comprehensive industrial assessments performed at no cost to the manufacturer.

Documents –

- ☐ IAC Database

Access the Web site at ***www.oit.doe.gov/iac***.

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For more information on Motor, Steam, Compressed Air Systems, and IACs, call the OIT Clearinghouse at (800) 862-2086, or access the Web site at *www.oit.doe.gov*.