Welcome! We will begin momentarily.

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Boiler Tune-Up and Maintenance
September 9th, 2009
Instructor-Greg Jourdan
Wenatchee Valley College

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Courtesy Cleaver-Brooks Boilers
The Basics of Boiler Tune-Up and Maintenance

Boilers are major energy users in many facilities. The combustion efficiency of a boiler will degrade over time necessitating a tune-up to restore efficiency of the unit.

- Boilers can be either steam or hot water; tune-up procedures apply to both types.
- A complete boiler Tune-Up measures the efficiency, corrects the problems, and measures efficiency regularly.
- A Tune-Up improves combustion efficiency by reducing stack losses and improving combustion.
- Regular Annual Maintenance includes inspecting, repairing as needed, cleaning, and adjusting the components of the boiler for optimum performance.

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Benefits of Boiler Tune-Up And Annual Maintenance

- Reduced energy consumption
- Reduced requirement for expensive repairs
- Improved efficiency will prolong boiler life
- Financial savings

Photos courtesy of TSI, ECMT Inc, and Testo Test Tools
Using a Flue Gas Analyzer
Determine Boiler Efficiency

Test boiler combustion efficiency and perform required adjustments on a regular basis to ensure peak operating performance.

Optimum efficiencies range between 75 to 80%, boiler efficiency can fall to 50% or less without proper maintenance and adjustment.

Done by trained maintenance staff or qualified contractors as a part of regular maintenance activities annually.

The combustion analyzer measures the:
CO₂, O₂, CO, Exhaust temperature
Boiler Excess Air

Excess air is required to achieve complete combustion
Â Is required for optimum efficiency at a minimum.
Â Depends on boiler configuration, burner design, controls and fuel type.
Â Determined by reducing O2 until CO starts to appear.
Â 2 % excess O2 with zero CO is achievable with gas-fired boilers.
Â Controlling excess air is the most important tool for managing boiler efficiency and emissions.
Example of Benefit of Reducing Excess Air from 11% to 2%

A Boiler operating at:
- O2 of 11% Excess Air
- Temperature of stack is 300° F
- Temperature of inlet combustion air is 85 ° F

Reducing the O2 from 11% to 2% will improve efficiency from **80% to 84%**
Causes of Boiler Combustion Inefficiencies

Combustion efficiencies lower than 75% may be caused by:

- Dirty fire side of the heat exchanger - an indicator of poorly adjusted burners.
- Dirty water/steam/air side of the heat exchanger - often an indication of poor water treatment.
- Inadequate combustion air (air shortage problems occur most often with natural draft boilers) - excessive combustion air.
Other Steps to Improve Boiler Efficiency

- Increase combustion air temperature
  - Consider air pre-heater
  - Draw air from a high point in the boiler room
- Clean Boiler Tubes as needed to improve heat transfer capacity of boiler
- Maintain Water Treatment to keep water side of boiler free of scale buildup
Potential Savings % by Increasing Combustion Efficiency

Enter left side column and find your existing efficiency. 
Go across the top and find you new efficiency. 
The percentage in the middle is your new fuel savings.

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Example of Percent of Potential Savings

Existing efficiency is 72%; new efficiency is 85%. By increasing your efficiency, you will save 18.06%.

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Benefits of Boiler Tune-Ups

On average, Un-tuned boilers may have combustion efficiencies of 60% or lower. As the exhaust temperature increases, the combustion efficiency decreases, as more heat is lost in the flue gases.

A well-tuned boiler can dramatically lower the fuel cost of operating a boiler or industrial process heater.

Example-At an average of 60 cents/therm, a 10,000-lb/hr boiler with an average annual capacity factor of 50% would save about $26,000 per year in fuel costs with a 10% increase in combustion efficiency. Even a 1% increase in efficiency would save about $2,600 per year.
Cost of Boiler Testing

The cost of testing and the implementation of typical remedial measures can range as follows:

Efficiency testing - $60 to $500
Chemical boiler cleaning - $800 to $1,500 to $2,000 to...
Water treatment/year - $1,500 to $3,500 to $4,500 to...
Burner adjustment - $200 to $500
Enlarge air intakes - $500 to $1,000

* Note-Boiler plant size dictates actual cleaning, chemicals, and water treatment costs.
Major Energy Saving Opportunities

Å As a Rule of Thumb, boiler efficiency can be increased by 1% for each 15% reduction in excess air or 40 degree reduction in stack temperature.
Å The clean operation of a boiler makes all the difference.
Å Just 1/16th layer of soot on the fire side of the boiler tube can cost 10% to 20% of the fuel efficiency, increasing fuel costs by 10% to 20%.
Å The same percent loss can also happen if scale on the water side of boiler tube is 2 human hairs thick.
Portable Analyzers vs. Automatic Stationary Trim Systems

Portable Flue Gas Analyzers

The flue gas can be measured by inexpensive gas-absorbing test kits. More expensive (ranging in cost from $500 to $10,000) hand-held, computer-based analyzers display percent oxygen, stack gas temperature, and boiler efficiency. They are a recommended investment for any boiler system with annual fuel costs exceeding $50,000.

Photos courtesy of TSI, ECMT Inc, and Testo Test Tools
Portable Analyzers vs. Automatic Stationary Trim Systems

Automatic Oxygen Control or $O_2$ Trim Systems

When fuel composition is highly variable or where steam flows are highly variable, an online oxygen analyzer should be considered. The oxygen trim system provides feedback to the burner controls to automatically minimize excess combustion air and optimize the air-to-fuel ratio.
Boiler Maintenance Recommendations

- Check water level at try cock valves.
- Annually clean and check the low water float safety controls.
- Check pop off relief valves as recommended by manufacturer.
- Check pressure controls.

Photos courtesy of Greg Jourdan
Boiler Tube Inspections

If the fire side of the heat exchanger is dirty, but the fuel/air mixture is correct, check for excessive boiler room dust.
  Remedy; clean the floor more often and paint the boiler room floor to reduce dust levels.
If the water side of a boiler has scale buildup, water treatment may be inadequate.
If the water side of a boiler appears to have corrosion
  Remedy, maintain proper water treatment levels as per water chemical expert recommendations.
Annual Maintenance

Clean fireside surfaces

- Brush & vacuum tubes
- Clean tube sheets & refractory
- Amount of soot indicates how well burner is performing

Courtesy Cleaver-Brooks Boilers
Annual Maintenance

Repair refractory

- Cracks 1/8\" and under will close up when heated
- Look for loose sections

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Annual Maintenance

Check hydraulic valves

- Bubble test for valve seat tightness check
- Actuators open & close properly

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Annual Maintenance

Remove and Recondition safety valves

- Inspect piping for loose hangers putting weight on valves

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Annual Maintenance

Recondition Boiler feed pumps

- Wear rings
- Seals
- Packing
- Bearings
- Recondition shaft and/or impellers

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Annual Maintenance

Check condensate receivers

- Flush out
- Check any lining for failure
- Clean pump strainers
Annual Maintenance

Check chemical feed system

- Clean out tank
- Recondition pump
- Inspect & clean out piping to injection points
Annual Maintenance

Tighten electrical terminals

- Power off!!
- All panels, all controls & components
Annual Maintenance

Check de-aerator or boiler feed system
- Water spray head
- Collector cone assembly & steam atomizing valve of spray types
- Check any possible lining
- Clean out pump strainers

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Annual Maintenance

Check linkages

- Lubricate
- Tighten
- Replace worn parts
Working with Outside Contractors Offering Boiler Tune-up Services

- Look for experienced contractors
- Verify combustion analyzers are calibrated annually
- Ask for combustion analyzer print-out report
- Don't just look for the cheapest contractor... look for quality!
- Ask your GAS Utility if Boiler Tune-Ups are subsidized.
Boiler manufacturer resources and Tune-Up Info

- Cleaver-Brooks
- Burnham Commercial Boilers
- Lochinvar Boilers
- Hays Cleveland Oxygen Trim Controllers
- Testo Combustion Analyzers
- Bacharach Combustion Analyzers
- TSI Test Tools
Thank –You
Questions?
For more information

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