

10 Ways to Improve Efficiency for Gas-Fired Boilers

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ARTICLE TOOLS

Look around your plant and find the opportunities for energy and performance improvements.

The need to operate a boiler efficiently in today's environment is at the top of many plant owner's and operator's lists. Unfortunately, operating a boiler efficiently and meeting local emission regulations do not always go hand in hand. However, advances in boiler system design and low NO_x technology solutions have made this a much more achievable task.

The potential for energy improvements and cost savings is substantial when you consider that most boilers operating today are performing at efficiencies that are less than 81 percent. These 10 tips take a total systems approach to managing boiler efficiency for natural gas-fired boilers. These general guidelines can help improve overall boiler performance and sustainability, allowing plants to achieve more cost-effective maintenance and operation of a steam system.

1. Reduce Excess Air

One of the first considerations when trying to improve boiler efficiency is to look at how excess air levels are being controlled. An often-stated rule of thumb is that boiler efficiency can be increased by 1 percent for each 15 percent reduction in excess air. With a properly designed O₂ trim system, the boiler will maximize combustion efficiency and minimize heat loss up the stack. In order to maintain excess air at optimum levels, ensure that boiler control systems are working properly and periodically have a qualified boiler/burner technician re-tune the boiler's burner.

2. Install an Economizer

In many boilers, useful amounts of energy still exist in the flue gases even after they have passed through the boiler. Economizers are designed to capture and transfer the exhaust heat of the flue gases to preheat incoming boiler feedwater. Extended-surface economizers are designed for maximum heat recovery and can decrease flue gas outlet stack temperature to as low as 250°F (121°C). In general, for each flue gas temperature decrease of 40°F (22°C), boiler efficiency is increased by 1 percent.

3. Install a Condensing Economizer

Condensing economizers are designed to pick up both sensible and latent heat by condensing flue gas water vapor. They have been designed to decrease the flue gas outlet stack temperature to as low as 100°F (38°C). Before considering the installation of a condensing economizer, be sure to determine how the condensed water from the flue gas will be disposed. Unlike a standard feedwater economizer, the low-grade heat produced cannot be used by the boiler system. A plant must have a need for constant low-grade heat (as with a hydronic heating or washdown application) for this to be a cost-effective option.

4. Upgrade Fan Controls

Variable-frequency drives (VFDs) adjust and control fan speed in response to the boiler load, so upgrading to VFD fan controls can help improve boiler efficiency. Standard constant-speed fan airflow is matched to

the boiler load by the opening and closing of a damper so horsepower stays relatively constant, regardless of the load (depending on damper arrangements). With VFDs, the exerted horsepower varies three times the fan speed. For example, if a fan operates at 75 percent of maximum operating speed, the required horsepower would only be 40 percent of full load compared to a constant speed fan. In addition to their energy-saving benefits, VFDs also can increase the service life of the fan motor, decrease maintenance costs and significantly reduce noise levels.

5. Consider Installing a Selective Catalytic Reduction (SCR) System

For applications requiring ultra-low NO_x operation, an SCR system with a standard no flue gas recirculation (FGR) low-excess air burner can use considerably less fan horsepower than a high FGR, high excess air ultra low NO_x burner. An ultra low NO_x burner requires a significantly larger fan and generally has limited turndown and response to load swings.

An SCR system with a standard burner can provide emission reductions to as low as 2.5 ppm NO_x depending on the application. It also can reduce energy demands and is able to handle most plant load swings with reliable boiler performance.

6. Perform Proper Water Treatment

Another major problem that affects boiler efficiency is poor water quality or water treatment. The main objective of any boiler treatment program is to prevent deposits and corrosion on the water side of the boiler. It is important to ensure that any water treatment equipment is designed for the particular makeup water entering the system. It is always worth considering reverse osmosis (RO) for makeup water treatment. RO reduces blowdown, which increases boiler efficiency and reduces boiler treatment chemicals. Having high condensate return also increases overall plant efficiency and reduces makeup water requirements.

7. Reduce Boiler Pressure

Any boiler that is operating at a pressure higher than the process requirements offers the potential to save energy by reducing boiler pressure. The boiler pressure directly corresponds to the water/saturation temperature in the boiler. A lower boiler operating pressure results in several efficiency gains, including higher LMTD (log mean temperature difference) between the flue gas and boiler saturation temperature, higher heat transfer, lower heat loss, lower outlet stack temperature and overall reduced fuel usage.

8. Consider Boiler Blowdown Heat Recovery

There are two types of boiler blowdown: continuous and bottom. Continuous blowdown removes dissolved solids from the water surface and is continuously operating. Bottom blowdown removes sediment that has settled to the bottom of the boiler and generally is used several times a day. The energy contained in the continuous blowdown can be used to preheat feedwater and supply flash steam to a deaerator, reducing overall steam required by the deaerator. Flash tank systems or a blowdown heat recovery system with a flash tank and a heat exchanger are two methods for recuperating energy in the blowdown.

9. Upgrade to a High Turndown Burner and Controls

Upgrading a boiler with a high turndown burner reduces boiler cycling and heat loss, and O₂ trim controls

provide feedback to the burner controls to optimize the air-to-fuel ratio. This controls excess air amounts and maximizes boiler efficiency gains.

10. Implement an Energy-Efficiency Program

A boiler efficiency improvement program includes two aspects: the actions needed to bring a boiler to peak efficiency and the actions needed to maintain the efficiency at the maximum level. The general guidelines above provide several opportunities for energy and performance improvements; however, it is up to the plant operator to look past the immediate demands of the equipment and take a broad view of how the system parameters affect the plant systems as a whole.

Many resources are available today to help operators develop a comprehensive strategy to increase efficiency, reduce emissions and boost productivity. Free plant assessments, training sessions offering by manufacturers, associations and industrial services, as well as software tools are readily available to help make decisions about implementing efficient practices in your facility a reality.