The Impact of Excess Air on Efficiency

Leading manufacturer of boiler room equipment across commercial, institutional, and industrial markets

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KEY FACTS

- Research has shown that 15% excess air is the optimal amount to introduce into the boiler combustion process
- Most boilers tend to increase excess air requirements at the lower end of the firing range, decreasing efficiency
- For accurate efficiency, request boiler efficiencies with actual excess air levels throughout the 10:1 turndown range

In theory, to have the most efficient combustion in any combustion process, the quantity of fuel and air would be in a perfect ratio to provide perfect combustion with no unused fuel or air. This type of theoretical perfect combustion is called stoichiometric combustion. In practice, however, for safety and maintenance needs, additional air beyond the theoretical "perfect ratio" needs to be added to the combustion process—this is referred to as "excess air."

With boiler combustion, if some excess air is not added to the combustion process, unburned fuel, soot, smoke, and carbon monoxide exhaust will create additional emissions and surface fouling. From a safety standpoint, properly controlling excess air reduces flame instability and other boiler hazards.

"Even though excess air is needed from a practical standpoint, too much excess air can lower boiler efficiency."

Even though excess air is needed from a practical standpoint, too much excess air can lower boiler efficiency. So a balance must be found between providing the optimal amount of excess air to achieve ideal combustion and prevent combustion problems associated with too little excess air, while not providing too much excess air to reduce boiler efficiency.

Research has shown that 15% excess air is the optimal amount of excess air to introduce into the boiler combustion process. While some boilers have been able to achieve 15% excess air at the top end of a boiler's firing range, the challenge presents itself at the lower end of the firing range, or below 60% of the boiler's maximum capacity.

In general, most boilers tend to increase excess air requirements as the firing rate of the boiler decreases, leading to lower efficiency at the lower end of the firing range.

For more information on CleaverBrooks Boiler efficiencies, visit http://www.cleaverbrooks.com/reference-center/resource-library/tip-sheets/2016-tip-sheets/the-impact-of-excess-air-on-efficiency.aspx

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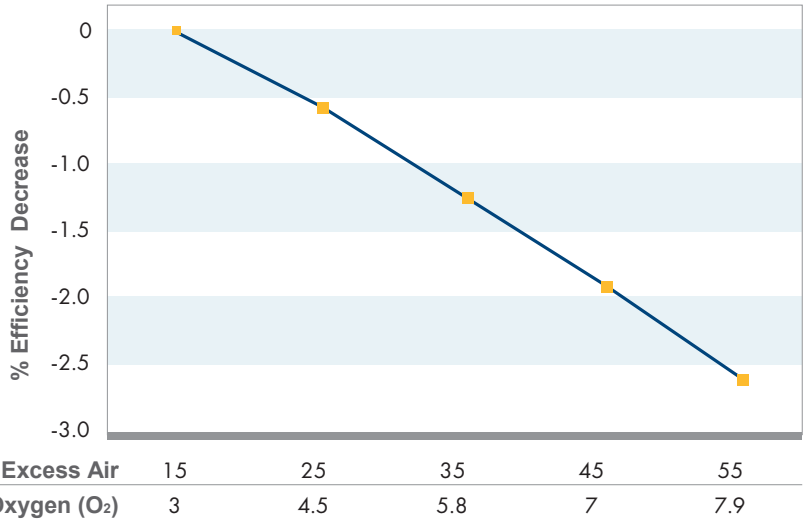
To complicate matters, most boilers operate on the lower end of the firing range—so selecting a boiler that has low excess air throughout the firing range is important. This will ensure that you are always operating at high efficiencies.

PUBLISHED BOILER EFFICIENCY AND EXCESS AIR

Most manufacturers will publish boiler efficiencies with either corrected levels of excess air or efficiencies only at the top end of the boiler capacity. This makes the boiler efficiency appear higher than it actually is. For a more accurate efficiency, ask for boiler efficiencies with actual excess air levels given throughout a 10:1 turndown range.

EXCESS AIR EFFECTS ON EFFICIENCY FOR NATURAL GAS



The terms excess air and excess oxygen are commonly used to define combustion. They can be used synonymously but have different units of measurements. The percentage of excess air is the amount of air above the stoichiometric requirement for complete combustion. The excess oxygen is the amount of oxygen in the incoming air not used during combustion and is related to percentage excess air. For example, 15% excess air equals 3% oxygen while firing natural gas.

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