Heat Treatment

INDUSTRY

- **Burner modulation**
- **Air/fuel cross-limiting**
- **Regulation of excess air**
- **Oxygen trim**
- **Total heat control**

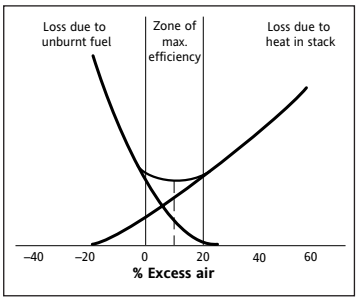
Modulating Burner combustion control for Heat Treatment Furnaces

Application Note

Fossil fuel burners are often used as the principle medium for delivering energy to Industrial Furnaces and Ovens.
Increasing focus on reducing energy costs has led manufacturers to concentrate on new burner design techniques and important advances in efficiency gains have been made over the years.
Burner management and control systems must be equally adaptive.
Eurotherm provide efficient, well implemented control techniques capable of reducing operating costs whilst providing resources for greater flexibility in plant management and control. Burner combustion generally includes one or a combination of the following methods.

- Regulation of excess air
- Oxygen trim
- Burner modulation
- Air/fuel cross-limiting
- Total heat control

Excess air regulation



In actual practice, gas, oil, coal burning and other systems do not do a perfect job of mixing the fuel and air under the best achievable conditions. Additionally, complete mixing may be a lengthy process. Figure 1 shows that in order to ensure complete combustion and reduce heat loss, excess air has to be kept within a suitable range.

Figure 1 Boiler efficiency

The regulation of excess air provides

- A better furnace heat transfer rate
- An ‘advance warning’ of flue gas problems (excess air coming out of the zone of maximum efficiency)
- Substantial savings on fuel

Oxygen trim

When a measurement of oxygen in the fuel gas is available, the combustion control mechanism can be vastly improved (since the percentage of oxygen in the flue is closely related to the amount of excess air) by adding an oxygen trim control module, allowing

- Tighter control of excess air to oxygen setpoint for better efficiency
- Faster return to setpoint following disturbances
- Tighter control over flue emissions
- Compliance with emissions standards
- Easy incorporation of carbon monoxide or opacity override

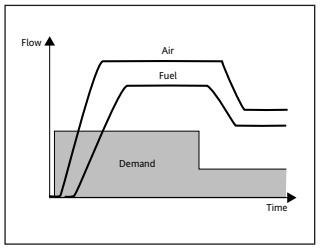
Burner modulation

Modulation control is a basic improvement in controlling combustion. A continuous demand signal is generated by a controller monitoring the Furnace atmosphere.

Reductions in temperature lead to an increase in firing rate. The advantages of introducing burner modulation in combustion control include.

- Fuel and air requirements are continuously matched to the combustion demand
- Furnace temperature is maintained within closer tolerances
- Greater Furnace efficiency
- Weighted average flue gas temperature is lower

Air/fuel cross-limiting



A cross-limiting combustion control strategy ensures that there can never be a dangerous ratio of air and fuel within a combustion process. This is implemented by always raising the air flow before allowing the fuel flow to increase, as shown in Figure 2, or by lowering the fuel flow before allowing the air flow to drop.

Figure 2 Cross-limiting combustion mechanism

Figure 3 depicts a simplified control block diagram of the cross limiting combustion circuit. Combination firing of multiple fuels simultaneously can also be easily accommodated within the scheme.

Cross-limiting combustion control is highly effective and can easily provide the following.

- Optimisation of fuel consumption
- Safer operating conditions by reducing risk of explosion
- Fast adaption to variations in fuel and air supplies
- Satisfaction of the plant demand for steam

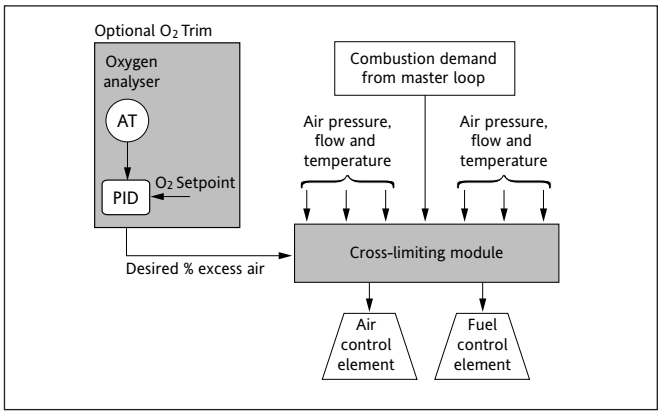


Figure 3 Cross-limiting combustion control with 06 trim

Enhanced cross-limiting

Double cross-limiting combustion control is an enhancement to the above. It is achieved by applying additional dynamic limits to air and fuel setpoints. This translates to having the actual air/fuel ratio maintained within a preset band during and after transition. This method protects against having the demand signal driving the air/fuel ratio too lean, therefore reducing heat loss.

Close coupled control

Most heat treatment processes require accurate control of the material temperature. With the advent of fast acting burners and burner control systems it is easy to implement very responsive cascade control to the furnace.

In this mode the burner is held under tight temperature control from a sensor very closely coupled to nthe delivered energy. The closely coupled slave loop responds to the demands of the master loop where the sensor is located within the work-piece. In this way the furnace can be completely optimised to the needs of both burner dynamics and the work-piece requirements giving maximum efficiency and guaranteed thermal processing.

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