Boiler

INDUSTRY

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

Burner combustion control for boilers

Application Note

Boilers are often the principal steam or hot water generator system used in industrial plant or commercial heating. Consequently, they must be designed to operate efficiently and safely whilst responding rapidly to any change in demand. Burner management systems must be equally adaptive. Eurotherm Process Automation provides efficient, well implemented control techniques capable of reducing operating costs whilst providing resources for greater flexibility in plant management and control. Burner combustion control 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

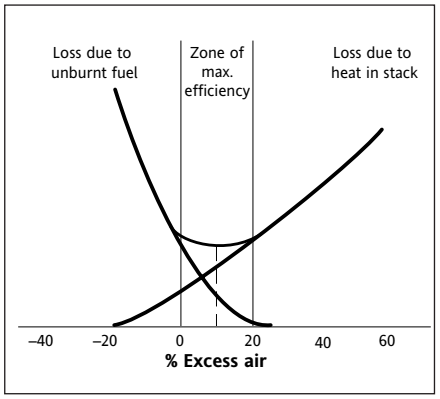
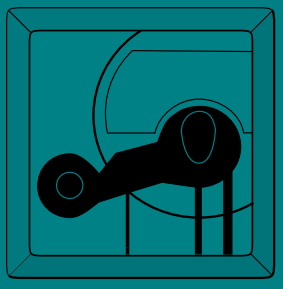


Figure 1 Boiler efficiency

In actual practice, gas, oil, coal burning and other systems do not do a perfect job of mixing the fuel and air even 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.

The regulation of excess air provides

- A better boiler 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 flue gas is available, the combustion control mechanism can be vastly improved (since the percentage of oxygen in 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

Modulating control is a basic improvement in controlling combustion. A continuous control signal is generated by a controller monitoring the steam or hot water line. Reductions in steam pressure or hot water 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
- Steam pressure or hot water temperature is maintained within closer tolerances
- Greater boiler 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.

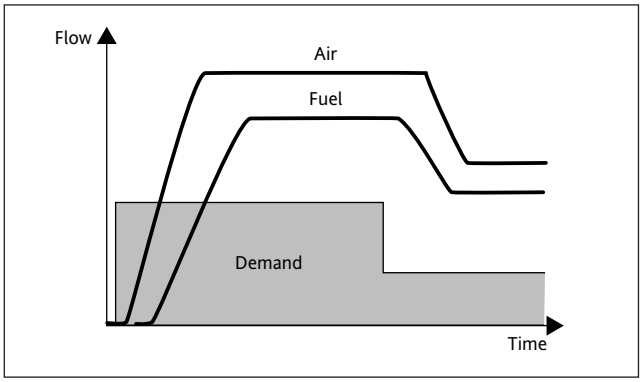


Figure 2 Cross-limiting combustion mechanism

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 adaptation to variations in fuel and air supplies
- Satisfaction of the plant demand for steam

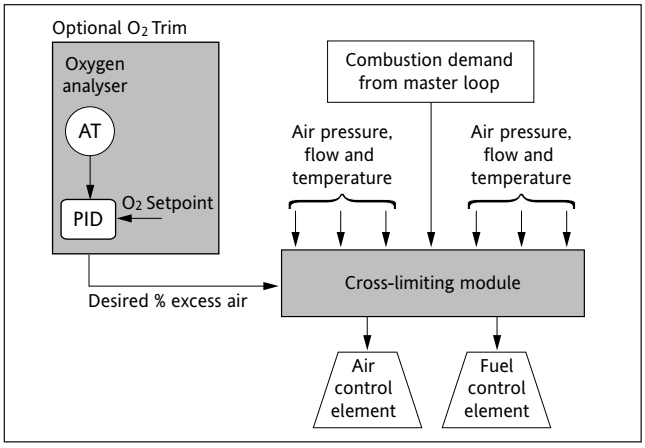


Figure 3 Cross-limiting combustion control with 06 trim

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.

Total heat control

In situations where combustion is not the principal heat source and when several factors contribute to the total heat to be generated by a boiler, a control loop can be introduced in order to monitor and manage the generated heat. This is particularly true for CHP plants, where gas turbines and supplementary firing are used. This type of implementation is shown in Figure 4.

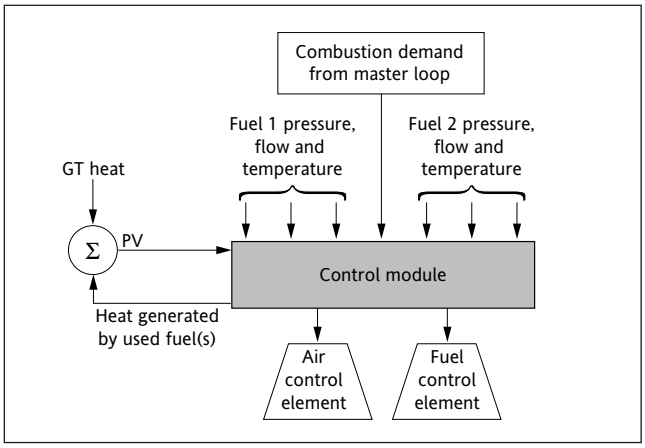


Figure 4 Total heat control

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