SENSORS & CONTROLS

Project Fact Sheet

THERMAL IMAGING CONTROL OF HIGH-TEMPERATURE FURNACES

BENEFITS

- Increased energy efficiency resulting in fuel savings of up to 5%
- Decreased emissions of CO and CO_2 by up to 5% and of NO_x by up to 30%
- Longer furnace life because of elimination of refractory hot spots and furnace instabilities
- Adaptability to many types of furnaces, assisting existing furnace control
- Transparent control to the operator
- Self-calibration

APPLICATIONS

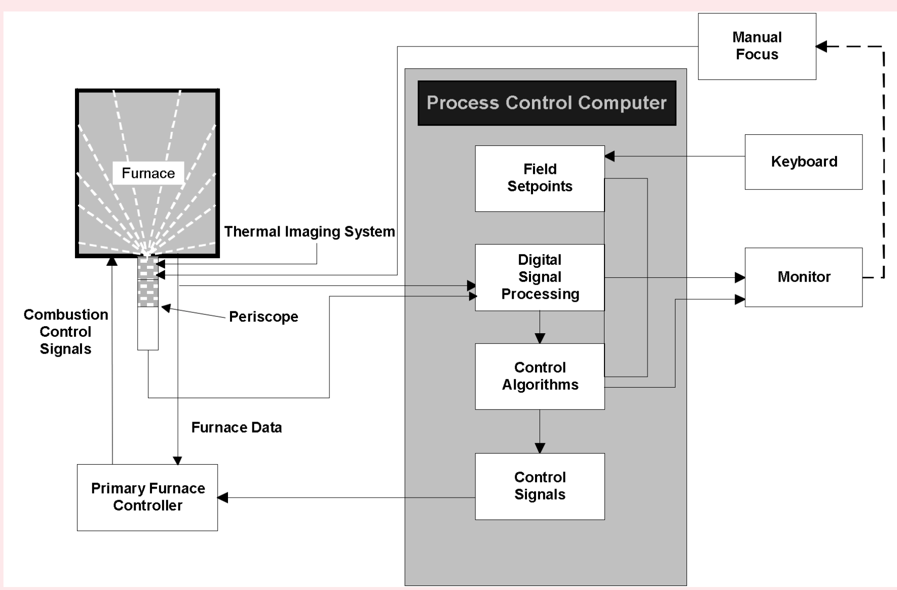
Application of this technology is targeted toward high-temperature materials processing furnaces, which consume more than 4 quadrillion Btu of energy per year and are operated by the steel, glass, aluminum, chemical, and metalcasting industries. In the steel industry alone, high-temperature furnaces are used for heating, melting, forging, brazing, and sintering operations. This technology works with thermal imaging hardware for field measurements, periscopes, and existing furnace controllers. Because it is aimed at fine-tuning, not replacing, the existing main furnace controller, improvement of combustion performance can be realized at relatively low cost and with little financial risk to end users—two primary concerns for new technology use.

THERMAL IMAGING CONTROL WILL MITIGATE HOT SPOTS AND INSTABILITY, YIELDING OPTIMIZED COMBUSTION PERFORMANCE

The near-infrared thermal imaging control system provides combustion performance improvements both in energy use and in airborne emissions reduction. This system applies control algorithms generating feedback control signals to minimize the difference between the actual field measurements and the set temperature values. Feedback control is sent to the main furnace controller from reading to reading, thus allowing the system to operate as an assisting controller to fine-tune a furnace for: increased efficiency, lowered emissions, elimination of hot spots, and mitigation of instabilities.

Optimizing the combustion process by providing heat at desired locations inside the furnace has been shown to allow a decrease of at least 5% of total fuel usage, with a corresponding decrease in airborne CO, CO_2, and NO_x emissions. This system offers benefits to many energy-intensive industries including steel, glass, aluminum, chemical, and metalcasting.

THERMAL IMAGING CONTROL



Thermal imaging control of high-temperature furnaces.

Project Description

Goal: Demonstrate and bring to commercial readiness a near-infrared thermal imaging control system for high-temperature furnaces that is rugged, self-calibrating, easy to install, and reliably transparent to the furnace operator.

The near-infrared thermal imaging system fine-tunes the main furnace controller for improved combustion performance. The system measures the intensity of 0.5 to 1 million pixels, using multiple infrared wavelengths combined with a periscope probe to map the full field of combustion space during operation. Control algorithms minimize differences between measured field temperatures and temperature set points and send output signals to the main furnace controller, from reading to reading, to assist with furnace combustion control.

A near-infrared thermal imaging control system will be developed and demonstrated to improve industrial process efficiencies and reduce airborne emissions. The system will be demonstrated on one or two industrial furnaces and afterwards will be marketed to all industries by a project team member.

Specific performance targets through use of the near-infrared thermal imaging control system include a decrease of at least 5% in total fuel usage and a reduction in NO_x production by 30%. Emissions of CO and CO_2 will automatically decrease 5% to match the decrease in energy input.

Progress and Milestones

This project was selected through the Sensors and Controls Program FY 1999 solicitation and was awarded in January 1999. All tasks are scheduled for completion in 36 months. Key tasks that have been performed or are planned are:

- Hardware for the thermal imaging system has been defined, and calibrated temperature maps at temperatures up to 1200°C have been obtained in real time.
- Software has been written to control the thermal imaging hardware and to process intensity maps into temperature maps.
- Temperature map data will be processed into forms needed by control algorithms, and work to interface with input temperature profiles will be conducted.
- Bench-scale testing of the complete thermal imaging system is expected to begin in Phase II on a heat treating furnace.
- Field demonstrations of the thermal imaging system will be conducted on industrial furnaces.
- A commercialization plan with a complete marketing approach will be developed. Project team member Eclipse Combustion is in a position to market the technology to industry.

Project Partners

Gas Technology Institute (Prime)
Des Plaines, IL

Combustion Tec/Eclipse Combustion
Orlando, FL

University of Illinois at Chicago
Chicago, IL

Owens Brockway Glass Containers
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