ENERGY UTILIZATION TECHNOLOGY

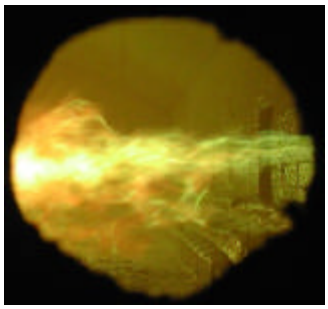
FOCUS

High-Luminosity, Low-NO_x Oxy-Natural Gas Burner for Glass Furnaces

Oxygen/natural gas combustion offers a number of benefits, including reduced NO_x emissions, better furnace control, a compact furnace system (e.g., elimination of regenerators for glass melters) and smaller flue gas cleaning equipment.

Despite significant progress in developing oxygen/natural gas combustors, current technologies provide fairly low flame luminosity, which prevents them from achieving the full production rate and thermal efficiency increases that are possible with oxygen-natural gas combustion.

Current technologies also generate relatively high levels of NOx emissions, even if only small amounts of nitrogen (from air infiltration, nitrogen in natural gas, oxygen, or feedstock) are present.



Objective
To develop an oxygen/natural gas-fired burner for high-temperature material processing furnaces that significantly:

- Increases production rate and thermal efficiency
- Reduces NOx emissions (even when using lower-cost industrial oxygen) compared to current oxygen/natural gas-fired technologies

Technology Description
The high-luminosity burner increases thermal efficiency and decreases NOx formation by increasing radiative heat transfer to the load. This concept combines a fuel modification (preheating) zone with staged combustion.

First, a small fraction (up to 10%) of the natural gas is burned. Products of this combustion are mixed with the main natural gas, producing hydrocarbon soot precursors in a heated oxygen-free environment. Preheated natural gas then enters the first, fuel-rich, combustion zone. Soot forms in the flame. The majority of the combustion occurs in the second, fuel-lean, combustion zone. Burning soot particles create a highly luminous flame that is more thermally efficient and cooler than a typical oxy-gas flame. Heat transfer uniformity is increased and NOx emissions are significantly reduced.

This new burner can be installed on new furnaces and can easily be retrofitted to existing air-gas and oxy-gas fired furnaces.

Benefits
This advanced oxy-gas burner technology can be applied to many materials processing furnaces, including glass and metal melting, heating, material treating and cement clinkering. The burner can be retrofitted on existing furnaces or as the combustion system of choice on new furnaces. Benefits include:

- Higher heat transfer to the load
- Cracking of natural gas generates soot particles, which increase luminosity and provide higher heat transfer as well as higher process and energy efficiency
- Lower flame and exit temperatures. Greater heat transfer from a more luminous flame generates a radiative cooling effect.
- Lower NO_x yield. Lower flame temperature and lower natural gas consumption lead to less NO_x.

Status
A patent was granted to GTI for the burner concept and another patent is anticipated for the final burner design. Eclipse, Inc., and GTI, are jointly developing this advanced oxygen/natural gas combustion technology. To date, project highlights include:

- Laboratory tests with 0.5 MM Btu/h prototype burners and with a full-scale 3 MMBtu/h prototype burner
- Field testing of all burners on an Owens Corning fiberglass melter. NO_xreduction of 50% versus baseline along with increase in energy efficiency.
- Field testing of all burners on a PPG Industries flat glass melter. Excellent flame patterns and high luminosity were achieved. Testing is still underway to quantify emissions reduction and fuel savings on the two field test furnaces.

Partners

- U.S. Department of Energy Office of Industrial Technologies
- Gas Research Institute
- New York State Energy Research and Development Authority
- Combustion Tec (Eclipse, Inc.)
- Owens Corning
- PPG Industries
- GTI Sustaining Membership Program

November 2002