An Innovative Hybrid Diffusion Burner Design for NOx Reduction in High Temperature Applications, Year Three of an Ongoing Study

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The project goal was to design and build a burner that could reduce NOx and increase radiant heat transfer while operating in the temperature range of 1200 to 1600 degrees C. The investigation started by reviewing existing low NOx burner designs in all temperature ranges. An original and unique design of a hybrid diffusion style burner was constructed. Premixing of the air fuel mixture combined with a hybrid staged nozzle were the salient design differences. For evaluation purposes, the burner was designed to be configured in such a way as to allow use in various air fuel formats and system arrangements. Acquisition of an industrial premixing burner system allowed for direct comparison of thermal efficiency and emissions. Emissions gases and temperature were measured utilizing a laboratory grade combustion gas analyzer and infrared camera/pyrometer. Recording of data was done with computer data logging software. Comparative testing was done over a range of O2 dilution rates and temperatures to establish an emission curve for predictive analysis. NOx, CO, CO2, O2 and back wall furnace temperature were analyzed. Compared to the commercial burner, the hybrid diffusion burner system showed an average 19% decrease in NOx and lower CO emissions while increasing the back wall furnace temperature at the lowest tested O2 dilution rate of 4%. The research shows that a hybrid diffusion burner design can reduce NOx emissions, increase thermal efficiency, and operate at high temperatures by utilizing a staged mixing system, staged nozzle, and diffusion techniques.

Awards Won:
Second Award of $1,500