Industrial Technologies Program

A New Generation of Smart, Integrated Burner/ Fired-Heater Systems

High-Efficiency, Ultra-Low-Emission, Integrated Process Heater System

The petroleum and chemical industries rely on process heaters to heat liquids and induce chemical reactions during production processing. Fired heaters in these two industries consume over 3 quadrillion Btu annually, nearly half of all fired heater energy use in the US manufacturing sector.

Despite this high energy use, fired heater designs have not changed appreciably in the last 20 years. Faced with the prospect of more stringent environmental regulations (especially for NOx emissions), the petroleum and chemical industries need new process heater designs and technologies to reduce emissions, increase efficiency, and improve cost/performance ratios.

TIAX, LLC, working with ExxonMobil Research and Engineering Company (EMRE) and Callidus Technologies, Inc. is developing and demonstrating the technology base for a new generation of process heater that is both highly efficient and extremely low in emissions.

The innovative system incorporates three advanced technologies:

1. ultra-low-emission (ULE) burners
2. a specially designed fired heater with enhanced heat recovery, optimized for use with the ULE burner systems
3. an on-line process tube temperature sensing and burner control system to enhance heat transfer, reduce maintenance costs, and increase run lengths

Figure 1—Test Components of Integrated Process Heater System

Test heaters and ultra-low-emission burner at Callidus Technologies.

Benefits

- *Potentially save 84 trillion Btu per year in the U.S. petroleum and chemicals industries by 2020*
- *Decrease NOx emissions by almost 150,000 tons annually*
- *Decrease CO2 emissions by 1.3 MMTCE annually*
- *Avoid $1.5 billion in capital costs via NOx reduction throughout the U.S. petroleum and chemicals industries*

Applications

Process heaters are widely used in a broad range of petroleum refining and chemicals processes. Advanced system components (burners, sensors, control systems, and heat exchangers) will be developed for use in both new and retrofit applications.

Project Partners

- *ExxonMobil Research and Engineering Company*
- *Callidus Technologies, Inc.*
- *TIAX, LLC*

Project Description

Goal: The goal of this project is to develop designs and components for an integrated process heater technology that maximizes system performance (in terms of efficiency, emissions, flexibility, reliability, and safety) while minimizing costs.

Activities: During the initial phases of the project, a prototype ultra-low-emission burner (2 million Btu/hour) was scaled up for commercial applications (9 million Btu/hour). In parallel, the design of a high efficiency advanced process heater, integrating the ULE burners, was developed.

To capture near-term benefits, system components (burners, sensors, control systems, and heat exchangers) are being designed for use in retrofit applications, either individually or in combination with each other. As the program progresses, those technologies shown to be both technically and economically feasible will be demonstrated at an ExxonMobil refinery.

Progress and Milestones

- An ultra-low-emission burner has been successfully developed and commercialized by the project team. Over one thousand ULE burners (4 - 40 million Btu/hr) have now been sold by Callidus (the commercialization partner). The primary market for the ULE burner has been the petroleum and chemical industries - particularly in the Houston-Galveston area, where stringent NOx emission requirements demand that industry apply technological innovations that reduce emissions while maintaining efficiency.
- The design for an advanced process heater has now been completed. The system integrates the ULE burner with innovative heat exchange, sensor and control technologies. Initial cost estimates for the design indicate that the advanced heater is attractive relative to current state-of-the-art technology.
- The team is now planning for specific field demonstration trials. These demonstrations will be structured to validate specific components of the advanced process heater system and will be conducted in 2004 and 2005.

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