PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

High Efficiency Engines and Turbines

12/2002

FUEL-AIR MIXING EXPLORED WITH OPTICAL PROBES, TOMOGRAPHY, AND LARGE EDDY SIMULATIONS

PRIMARY PARTNER

University of California, Berkeley

TOTAL ESTIMATED COST

$ 291,350

CUSTOMER SERVICE

800-553-7681

STRATEGIC CENTER FOR NATURAL GAS WEBSITE

www.netl.doe.gov/scng

Description

Under the Advanced Gas Turbine Systems (AGTSR) program, the University of California at Berkeley (UCB) is conducting laboratory experiments and computational development for new diagnostic approaches to measure fuel-air mixing in premixers of gas turbine combustors. Task 1 develops light emitting diodes (LED) for sampling CO_2, CO, NO_X, and other gases. Task 2 evaluates tomographic reconstruction for determination of spatially resolved rms fuel concentration at the entire exit of a premixer. Task 3 advances the capability to superimpose the beam from a red HeNe laser with the beam from IR HeNe laser to measure both fuel droplets and gas phase fuel concentrations. Task 4 builds improved computational models for predicting mixing in combustors and interpreting the data from earlier tasks. Transient and three-dimensional effects, largely ignored in current CFD calculations, will be incorporated into the computational models.

To date, the project has experimentally evaluated infrared light emitting diodes (IR LED) for measuring fuel-air mixedness. Light emitting diodes have only recently become available in the infrared light bands. They offer the advantage of less than one-third of the cost of HeNe lasers for measuring mixedness and are more compact and rugged. Based on the laboratory experiments, UCB has demonstrated that fuel concentration is measurable with an IR LED device at fuel-air ratios of lean premixed gas turbine combustors. An objective is to propose a reduced cost, compact and rugged diagnostic IR LED instrument for measuring fuel-air fluctuations in gas turbine premixers.

Duration

36 months

Fuel-Air Mixing Explored with Optical Probes, Tomography, and Large Eddy Simulations

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Goals

The goal of this project is to develop advanced lower cost, simpler and more rugged approaches for measuring premixing of fuel and air in turbine combustors.

Benefits

Thorough premixing of fuel in air is critical for low emission performance of turbine combustors. Without thorough premixing, NO_X emissions from turbine combustors are unacceptable, as shown in Figure 1. Improved measurement of fuel-air mixing resulting from this project is important for the development testing of advanced low emission turbine combustors and might be used for monitoring and tuning emissions performance of operating turbines.

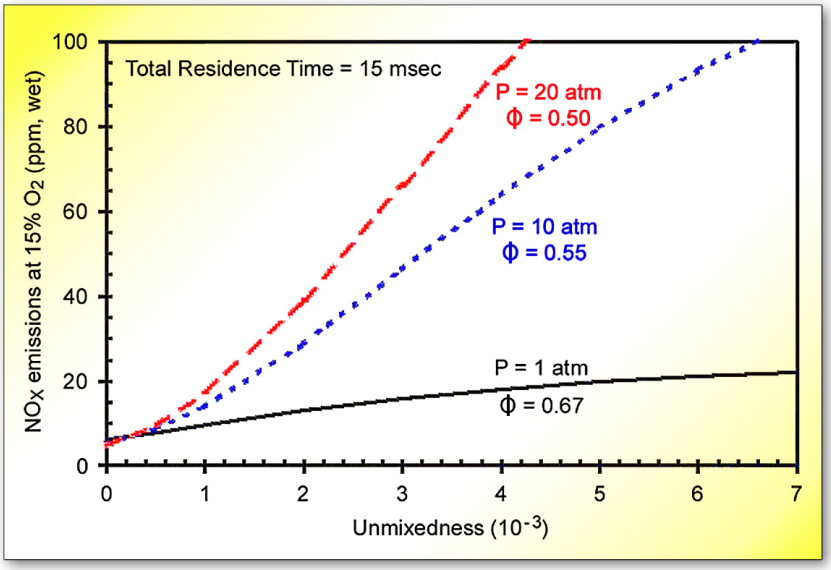

Figure 1. Unmixedness increases NO_X emissions