PROJECT facts

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

Gasification Technologies

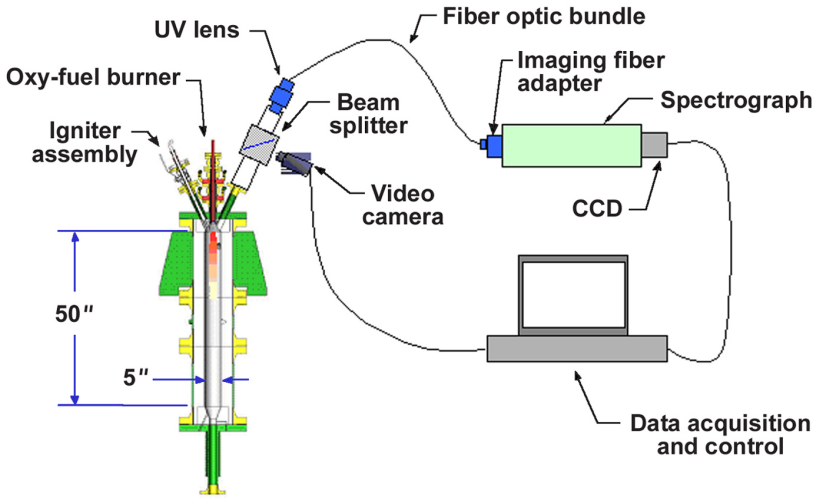
03/2008

REAL TIME FLAME MONITORING OF GASIFIER BURNER AND INJECTORS

Description

Combustion scientists and engineers have studied radiant emissions of various flames for many years. For some time, technologists have understood the rich potential for flame sensors to maintain burners at optimum performance, decrease emissions of carbon monoxide (CO) and nitrous oxides (NO_x), determine burner wear, and precisely turn down burners. Sensors monitoring broad infrared, visible, and ultraviolet regions are routinely used today to monitor flames. These sensors allow furnace operators to manually adjust appropriate burner controls to change, for example, flame length or firing rate as well as to maintain safe and stable combustion. However, the sensitivity and design of these sensors makes them incapable of deeper qualitative and quantitative monitoring and analyses of complicated combustion processes, such as in the coal gasification processes.

This project will develop a sensor that goes beyond the capabilities of existing combustion sensors, developing a flame monitor to help minimize the maintenance costs of gasifier operation. The flame characteristics monitored by this sensor will be flame shape, flame mixing patterns, flame rich/lean zones distribution, and hydrocarbon oxidation dynamics, flame stability and flame temperature. The sensor will be tested first at lab scale on natural gas flame, at bench scale in the vertical coal slurry oxygen enriched air combustor, and at pilot scale in an oxygen-fired, high pressure pilot-scale slagging gasifier. Both the bench and pilot scale work will be performed at CANMET Energy Technology Center (CETC) at Ottawa, Canada. Field demonstration tests will



Instrumentation used for accessing CETC gasifier flames using fiber optic coupling

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PERIOD OF PERFORMANCE

10/1/2002 – 8/31/2008

COST

Total Project Value
$1,237,464

DOE/Non-DOE Share
$917,329 / $320,135

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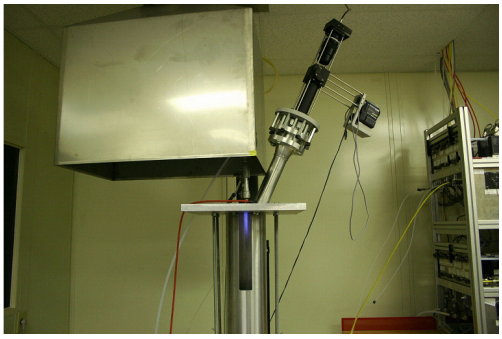
be performed on an oxygen-fired commercial-scale gasifier at the Wabash facility, with ConocoPhillips as the industrial partner. The result of this project is expected to be a simplified, industrially-robust flame characteristics sensor able to provide reliable information on the wear of coal gasifier feed injectors, thereby improving injector life in gasification systems.

Primary Project Goal

The primary goal of this project is to develop a reliable, practical, and cost-effective means of monitoring coal gasifier feed injector flame characteristics using a modified version of an optical flame sensor already under development.

Accomplishments

- Completed existing sensor modification to detect UV, visible and/or near IR wavelengths for optimum flame monitoring.
- Completed lab-scale testing of the flame sensor on natural gas flames.
- The sensor was modified for the pilot scale testing at the CETC oxygen-fired, high pressure pilot-scale slagging gasifier, and was successfully tested on a natural gas mockup of this gasifier. Flame parameters including swirl intensity, coal feed rate, coal feed velocity, and oxygen content in the oxidizer were varied during the tests.
- Pilot-scale tests were completed using the CETC pressurized entrained flow gasifier. These tests were designed to generate flames representative of Wabash River coal gasifier flame conditions at different stages of injector life.
- Negotiations are complete with Wabash Facility operators and management (ConocoPhillips) for them to partner in testing the flame monitor at their facility, enabling flame monitor tests on a commercial gasifier.



Sensor optical access assembly Installed at the gasifier mockup

Benefits

A reliable real time flame monitor for gasifier injectors will allow gasifier operators to more accurately plan for injector replacement, thereby increasing gasifier reliability and decreasing the frequency of injector replacements, ultimately saving money. The sensor data on real flame characteristics may also assist in the development of better, longer-lasting injectors, which would also lead to gasifier operation savings.

2-D optical sensor positioned for data acquisition from the natural gas test burner