PROJECT facts

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

Advanced Research

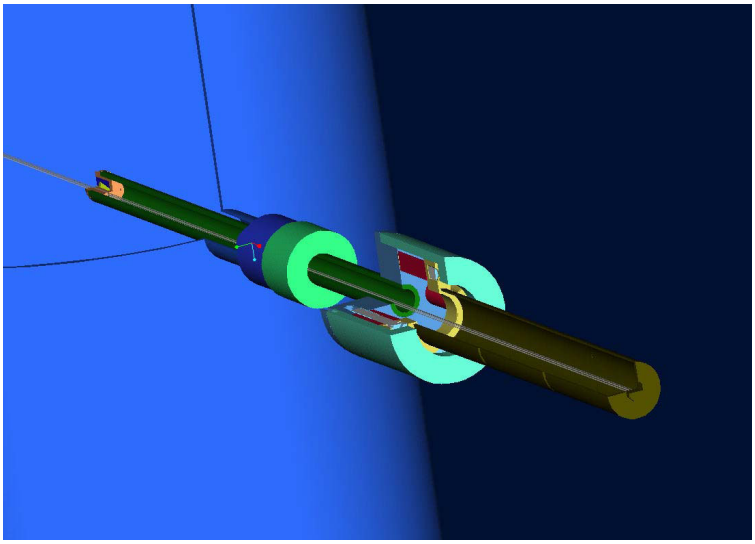
09/2004

HIGH TEMPERATURE SOLIDS VELOCITY PROBE

Description

The purpose of this research is to design and test a laser-based probe to measure solids velocity and direction in the riser section of a circulating fluidized bed at high temperatures. These measurements at high temperature will aid in the development of models to accurately predict the behavior of fluidized bed combustors and gasifiers. The improved models would advance the design of circulating fluidized bed reactors and in the control of the reaction process.

The Solids Velocity Measurement Probe (SVMP) has been machined using high temperature materials (2200 °F) and a sapphire lens to withstand corrosive high temperature environments. A HeNe laser energy source and beam forming optic system is used to generate four parallel beams that pass through the probe. Passing particles cause reflections of the laser beams to be picked up and coupled into fiber optics running through the length of the probe. An Avalanche Photo Diode (APD) is housed in the back of the probe and generates electrical pulses from light reflections conducted by the fiber optic elements. Software has been written to interpret these electrical signals in real time and generate statistics on velocity and direction.



3D Image of High Temperature Solids Velocity Probe and Housing

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PROJECT COST

Total $250,000

PROJECT DURATION

8/13/2001 – 05/31/2004

WEBSITES

www.netl.doe.gov/coal

A 1000 °C industrial oven has been used to verify high temperature performance of both the probe body and the unique light gathering sapphire lens system. Software tuning and testing has been performed in a cold flow circulating fluidized bed pilot scale unit at NETL. The APD signal amplification and filtering circuitry has been completely redesigned to eliminate environmental electrical noise. An improved software algorithm incorporates a function that automatically adjusts itself to eliminate varying test environment light conditions without operator intervention. Final system shakedown is being conducted after these recent system enhancements and high temperature pilot scale test is planned to demonstrate the operability of the sensor.

While the probe and software algorithm have been designed for a defined range of conditions and solid particle diameters, the ability to measure velocity of different particles can be accomplished with minor adjustments to the probe and data acquisition system.

High Temperature Oven Testing of Solids Velocity Probe