Abstract

Project Title:	**Innovative Instrumentation and Analysis of the Temperature Measurement for High Temperature Gasification**
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OBJECTIVE(S):

The temperature measurement in the gasifier, under harsh conditions, is a great challenge in terms of robust operation and corrosion/erosion prevention. The objective of this research is to develop innovative instrumentation and analysis for high temperature measurement in gasification using the specially designed thermocouples along with two cleaning methods. The ultrasonic dirt peeling and high-pressure oxygen injection cleaning are the two methods to clean the thermocouple tip for accurate and robust measurements. The anti-erosion/corrosion sprayed coating on the thermocouple could make the thermocouple specialized and unique.

ACCOMPLISHMENTS TO DATE:

Several methods of ultrasonic vabration generation were designed and applied with different performances. A specialized ultrasonic welder was selected to generate the ultrasonic vibration for the systematic tests. The ambient temperature and the high temperature testing environments were arranged separately for the systematic tests on the ultrasonic vibration application. The sticky dirt environment on the thermocouple tip was simulated by the cement-covered layer on the thermocouple tip. Four (4) input factors were considered to affect the response variables of the peeling off rate at the ambient temperature environment. The input factors include the different shapes of the cement-covered layers (i.e. thickness and length), the ultrasonic vibration output power, and application time.

At the high temperature tests, four (4) different environments were considered as the experimental parameters: (i) air flow supply, (ii) water and air supply environment, (iii) water, air, and fine dust particle supply, and (iv) air, water, ammonia, and fine dust particle supply environment. The factorial design method was used for the experiment design along with twelve (12) data sets of readings.

Analysis of Variances (ANOVA) was applied to the results from systematic tests. The ANOVA results showed that the thickness and length of the cement-covered layer have the significant impact on the peeling off rate of ultrasonic vibration application at the ambient temperature environment. For the high temperature tests, the different environments do not seem to have

significant impact on the temperature changes. These results may indicate that the ultrasonic vibration is one of the best cleaning methods for the thermocouple tip in high temperature gasification.

FUTURE WORK:

Complete the systematic tests on thermocouple probe with different coating conditions.
Analyze and evaluate the impacts of the coating conditions to the temperature measurements.

LIST OF PAPER PUBLISHED, U.S. PATENT/PATENT APPLICATION(S), CONFERENCE PRESENTATIONS, AWARDS RECEIVED AS A RESULT OF SUPPORTED RESEARCH, STUDENTS SUPPORTED UNDER THIS GRANT

Symposium Presentation

1. "Innovative High Temperature Measurement and Analysis in a Gasifier Simulator", Zhu, S., Y. Liu, J. Ngeru, and S.W. Lee, presented and published in the Proceedings of 11th Annual Undergraduate and Graduate Science Research Symposium, April 2004, Baltimore, MD.

Conference Presentation and Award

1. "The Advanced Temperature Techniques for the Lab-scale Gasifier", Shelton, C., and S.W. Lee, presented and awarded honorable price at the Annual Conference of NSBE, February 2005, Baltimore, MD.

Professional Journal

1. S. Zhu, S. Lee, Co-combustion Performance of Poultry Waste and Natural Gas in the Advanced Swirling Fluidized Bed Combustor (SFBC), in publication on Intl. Journal of Integrated Waste Management, Science and Technology, Vol. 25, Issue 3, 2005.
2. Liu, Y., and S. Lee, "Modeling of the Transient Particle Velocity Distribution in the Fluidized Bed Combustor (FBC) Riser", published in an International Journal of Particulate Science and Technology, Vol. 23, 1-16, 2005.

Students Supported Under this Grant:

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