TITLE: Heterogeneous Reburning by Mixed Fuels

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ABSTRACT

OBJEVTIVE:
The objective of the Phase II study is to bring the mixed fuel concept developed earlier to a technological fast track. This objective is achieved by simultaneously demonstrating the concept on a larger scale unit, and by acquiring additional scientific information critically needed for process optimization. Specifically, we plan to address the following issues:

1. design of mixed fuels for effective NO reduction,
2. measurements of rate constants of NO reduction on young chars,
3. construction of a semi-empirical kinetic model,
4. reaction mechanisms in burnout zone, and,
5. demonstration of the mixed fuel concept on a pilot-scale down-fired furnace.

ACCOMPLISHMENTS TO DATE:
In an earlier project supported by the DOE, we elucidated the mechanism of NO reduction on lignite char in reburning environments (Chen and Tang, AIChE Journal, **47**(12), 2781-2797, 2001). This mechanism suggests the potential effectiveness of using a multi-function reburning fuel for NO reduction. In the current project, quantifications of total fixed nitrogen (NO, HCN and NH_3) exiting a simulating reburning reactor imply, by careful design of a mixed fuel and reaction conditions, reburning technology is likely to meet the US Environmental Protection Agency's regulation of removing 85%, or 0.15 lb/million Btu, of NO_x in a three-stage reburning process. This level of NO reduction is achieved at a moderately rich reburning stoichiometric ratio 0.945. A provisional patent application is under preparation.

In the early stage of this project, it was also demonstrated that the reaction mechanism could be applied to post combustion zone where the temperature is relatively low and oxygen is in excess.

This approach appears to be effective to NO reduction in the post-combustion zoned of both coal-fired boilers and automobile engines. We are currently measuring the rate constants for this heterogeneous reaction for the design of pilot-scale processes. It is expected that another patent application will be filed in the coming year.

FUTURE WORK:

We plan to continue the tasks discussed in the Objective section.

LIST OF PAPER, PATENTS AND PRESENTATIONS:

Chen, W.Y., and B.B. Gathitu, "Design of Reburning Fuel," presented at the Annual Meeting of the American Institute of Chemical Engineers, Paper #548c, Austin, TX, November 7-14, 2004.

Chen, W.Y., and B.B. Gathitu, "Design of Reburning Fuels," presented at the First Annual Intellectual Property Forum and Technology Expo, Jackson, Mississippi, November 30 - December 1, 2004.

Chen, W.Y., and B.B. Gathitu, "Heterogeneous Reburning by Mixed Fuels," to be presented at the 5th International Symposium on Multiphase Flow, Heat and Mass Transfer, and Energy Conversion, Xian, China, July 3-8, 2005.

Chen, W.Y., and H. Sarv, "In-Furnace Reduction of Nitrogen Oxide by Mixed Fuels," provisional patent submitted through the University of Mississippi, 2005.

Chen, W.Y., "Post-Combustion Reduction of Nitrogen Oxide from Stationary and Mobile Sources," invention disclosure to be submitted to the University of Mississippi, 2005.