TITLE: FLY ASH CATALYZED MERCURY OXIDATION CHLORINATION REACTIONS

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OBJECTIVES:

The main goal of this study is to investigate the mechanism of surface-assisted mercury transformation reactions in the combustor cool zone. To achieve this goal, we will investigate the interaction between $Hg^0(g)$ and fly ash particles under various post-combustion reaction conditions. Role of fly ash composition (metal constituents, carbon and calcium) on mercury transformation reactions will be investigated and impact of CO, SO_2 , NO/NO_2 and HCl concentration on mercury transformation reactions will also be determined.

ACCOMPLISHMENTS TO DATE:

The main goal of this study is to investigate the mechanism of surface-assisted mercury transformation reactions in the combustor cool zone. To achieve this goal, we are investigating interactions between $Hg^0(g)$ and fly ash particles under various post-combustion reaction conditions. This includes investigation of the role of fly ash composition (metal constituents, carbon and calcium) on mercury transformation reactions and impact of CO, SO_2 , NO/NO_2, and HCl concentration on mercury transformation reactions. For this study we obtained and characterized ten fly ash samples from five different coal-burning power plants. This characterization included investigation of adsorption/desorption isotherms. These fly ash samples were then used to conduct initial mercury oxidation experiments. From the results of the initial mercury oxidation experiments it was observed that the yields of oxidized mercury were directly correlated with carbon content of the fly ash samples. To better understand the relationship between mercury oxidation and the carbon content of the fly ash, a selected set of mercury oxidation experiments were conducted using just soot as a surface. The

results showed that soot, especially in the presence of HCl, can oxidize mercury under the post-combustion zone conditions. The impact of halogens (chlorine and bromine) on mercury oxidation was further investigated by conducting experiments with both HCL and HBr. The results show that addition of both HBr and HCl enhances mercury oxidation. A comparison of HBr and HCl data shows that under the post-combustion zone conditions HCl is a slightly better oxidizing agent than HBr.

FUTURE WORK:

In the next quarter we plan to complete the following tasks.

I. The results from our water (5% v/v) experiments suggest that addition of water inhibits mercury oxidation. However, these results also show that addition of water results in higher retention of mercury on ash surface. This is unexpected result. To further understand role of water we plan to conduct experiments with different water concentrations (0.5%, 2%, 10%) to see how change in water concentration effects mercury reactions.

II. We will use statistical tools (PCA) correlate mercury transformation ($Hg^0 \leftrightarrow Hg^{+2}$) with fly ash and flue gas composition.

LIST OF PAPER PUBLISHED, U.S. PATENT/PATENT APPLICATION(S), CONFERENCE PRESENTATION, AWARDS RECEIVED AS A RESULT OF SUPPORTED RESEARCH:

P. Varanasi and S. S. Sidhu, "Mercury transformation reactions on model fly ashes," **Proceedings 23rd Pittsburgh Coal Conference**, pg 28-1, Pittsburg, USA, 25-28th September, 2006.

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