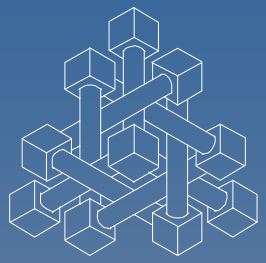


SOUTHERN RESEARCH

INSTITUTE

The Effect of Coal Type and Burnout on Mercury Speciation Across a Baghouse

Thomas K. Gale

Acknowledgements

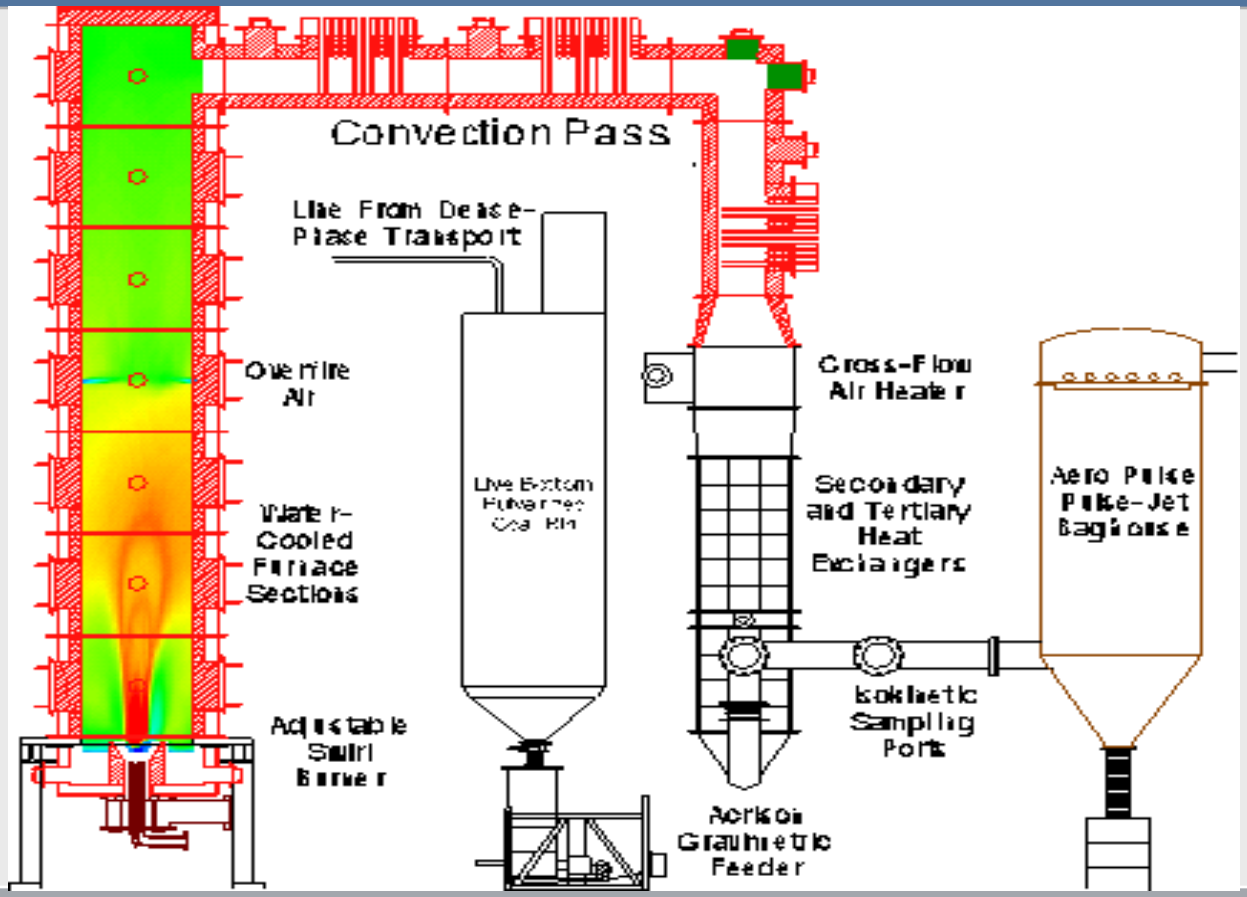
- Barbara Carney -- DOE Project Manager
- DOE Contract: DE-PS26-02NT41183
- We would also like to thank EPA and EPRI

SOUTHERN RESEARCH
INSTITUTE

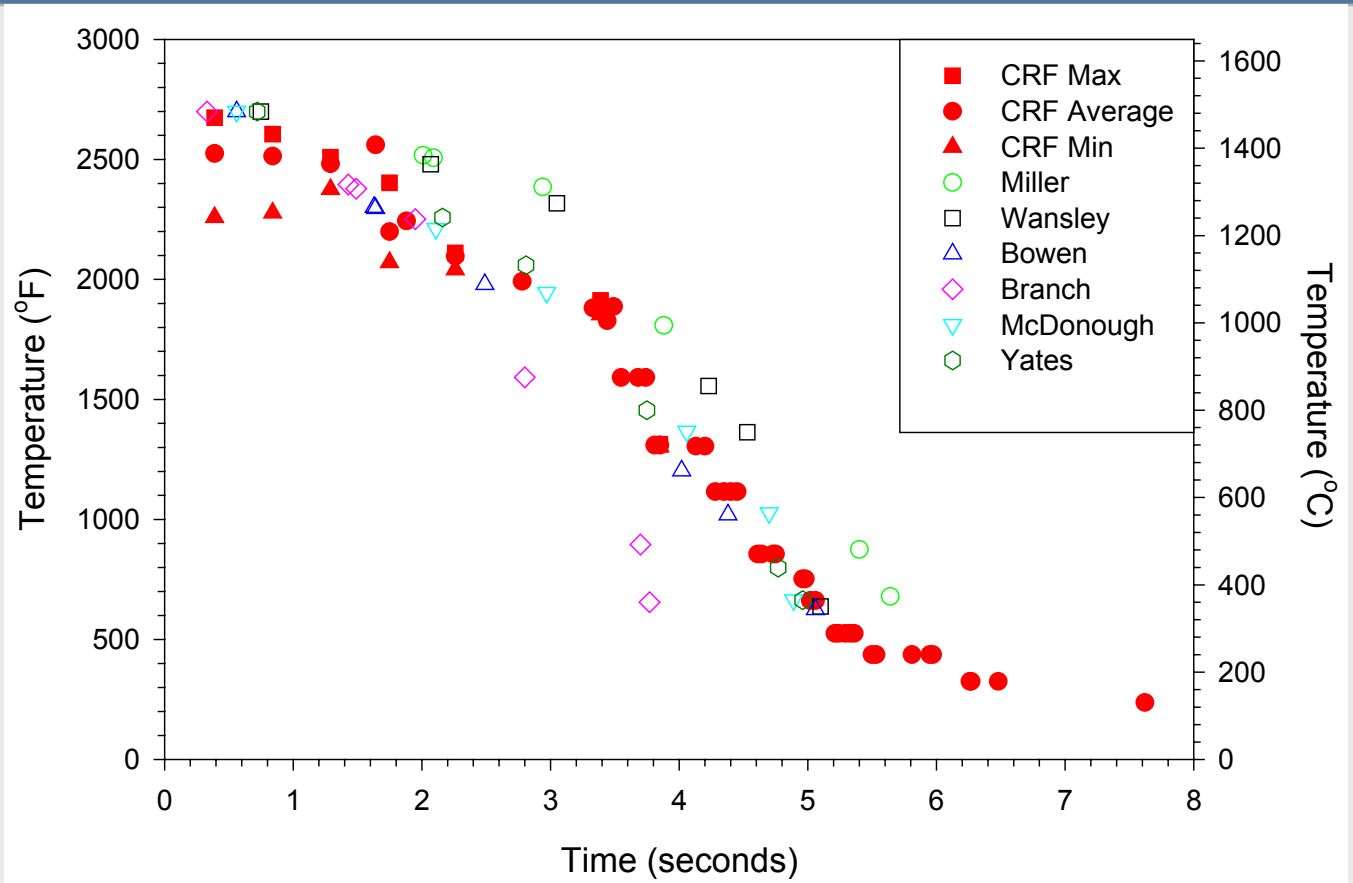
Outline

- Experimental
- Parametric Investigation Across Baghouse
  - Chlorine
  - General Flue Gas Components
  - Flyash Contributions
  - Synergism between UBC and Calcium

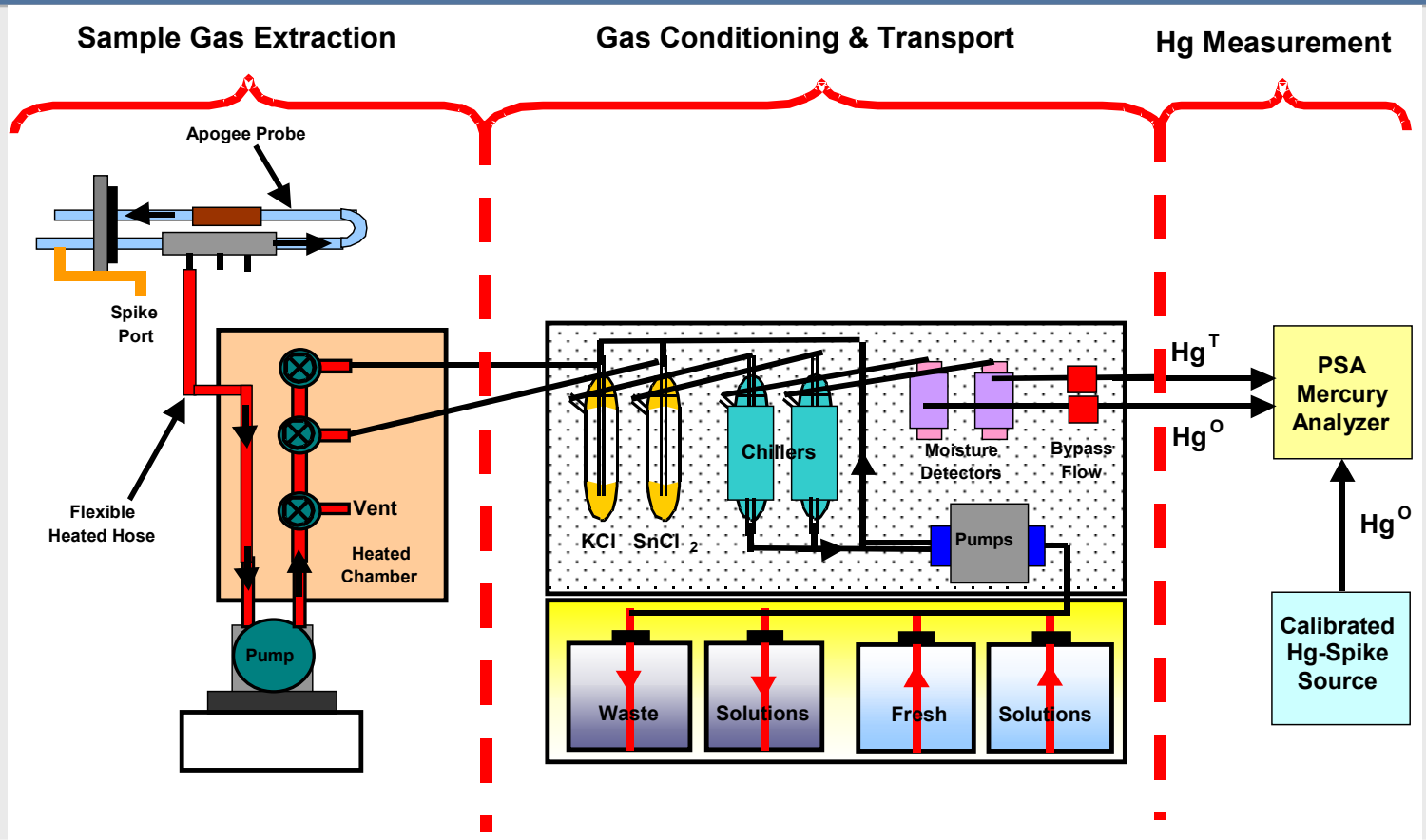
Combustion Research Facility



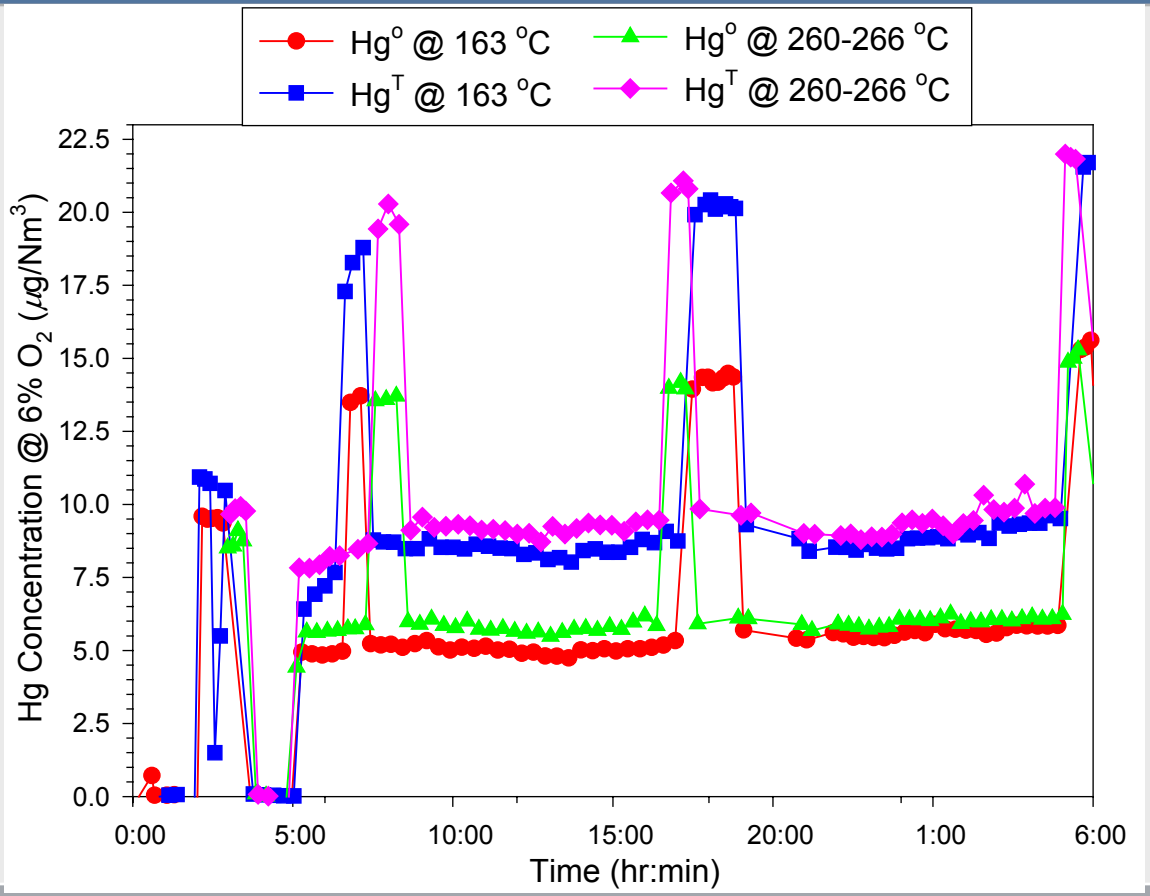
CRF $^{dT}/_{dt}$ Compared to Full-Scale



Mercury Monitoring System Including Spike and Recovery



Example of Data from Monitor Using Spike and Recovery

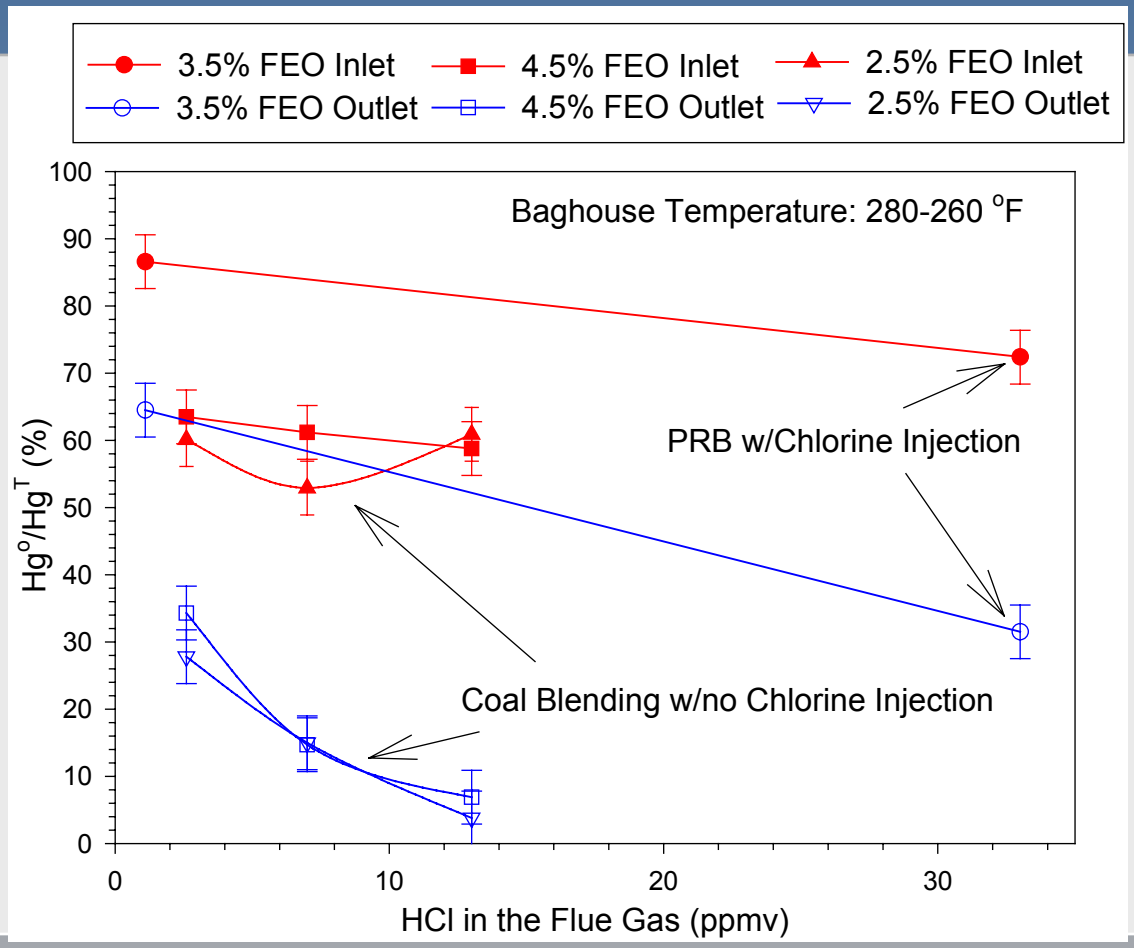


Hg-Speciation Investigation Starts by Explaining Observed Differences

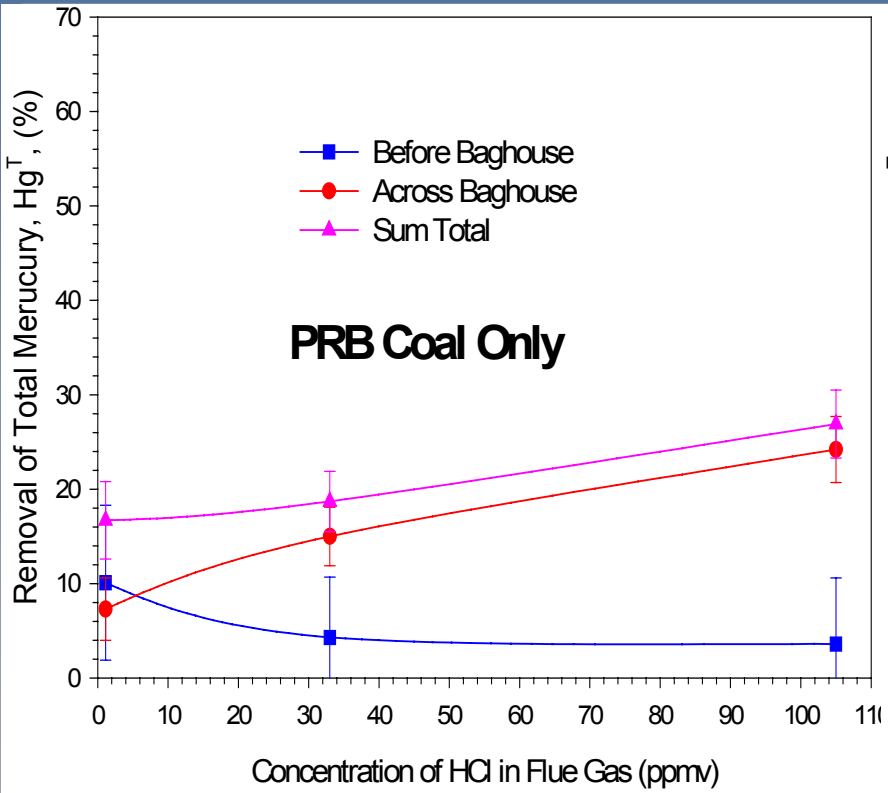
- PRB Coal *compared with* Bituminous Coal
- via coal blending

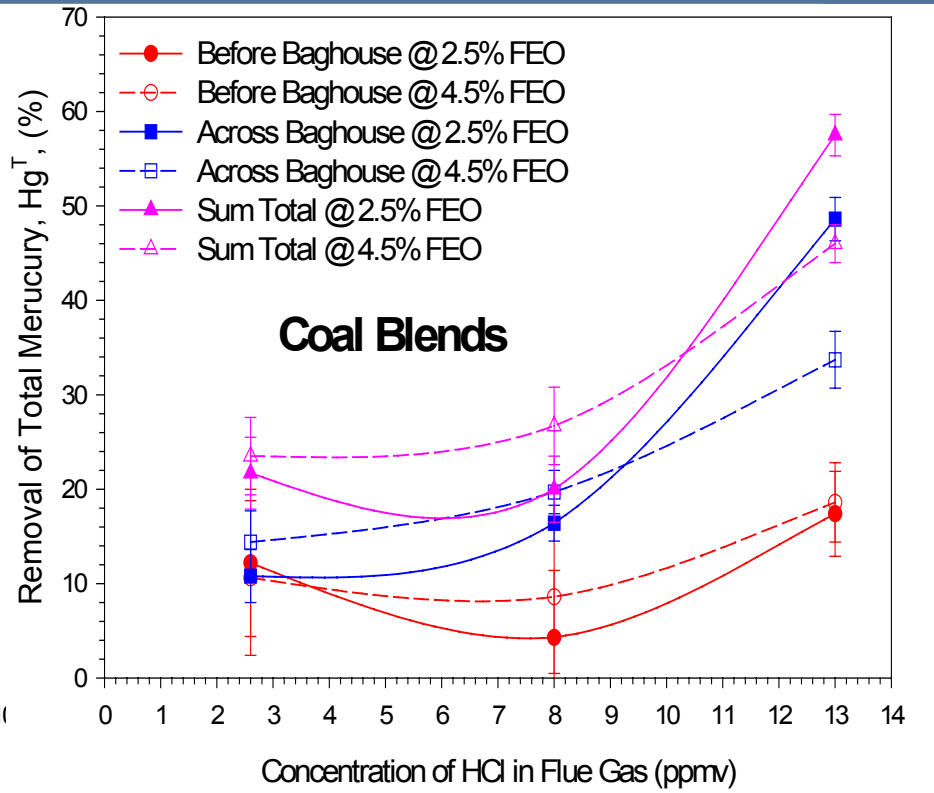
- Hg-Oxidation
- Hg-Capture

Effect of Flue-Gas Chlorine on Hg-Oxidation



Effect of Chlorine on Hg-Removal

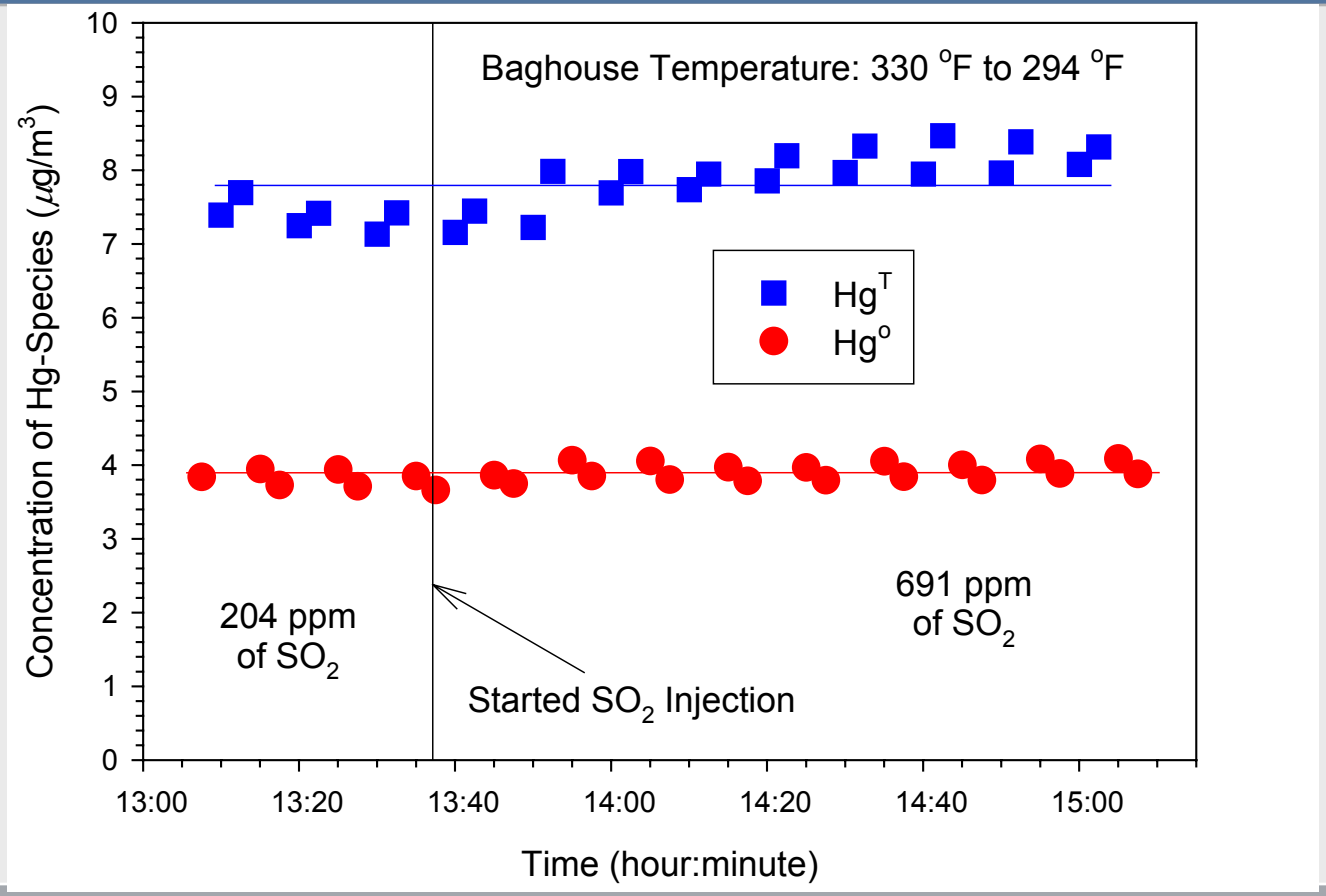




Isolated and Non-Correlated Parameters

- NO Correlation with CO_2, CO, O_2
- NO Correlation with NO_x or H_2O
- Through Isolation -- NOT SO_2
- What's Left? UBC and Coal Minerals

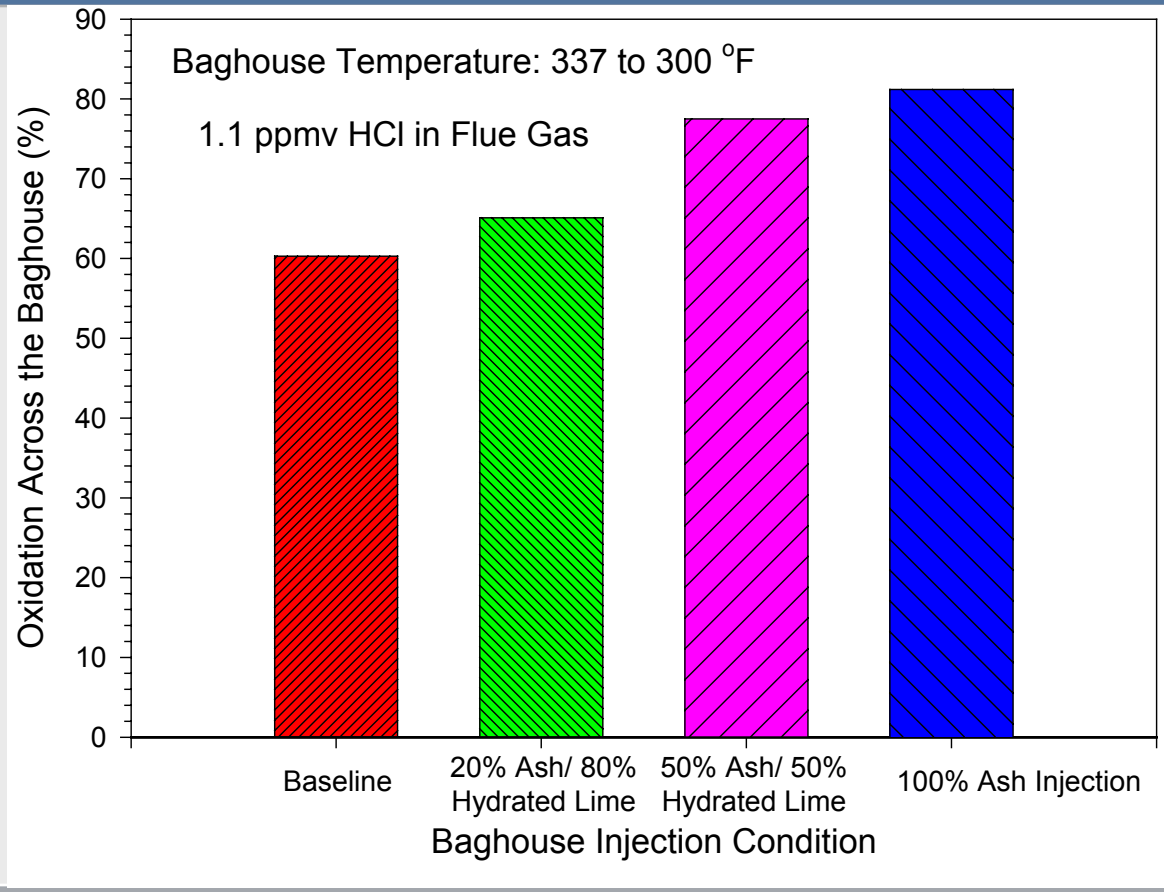
Effect of SO_2 on Hg-Speciation



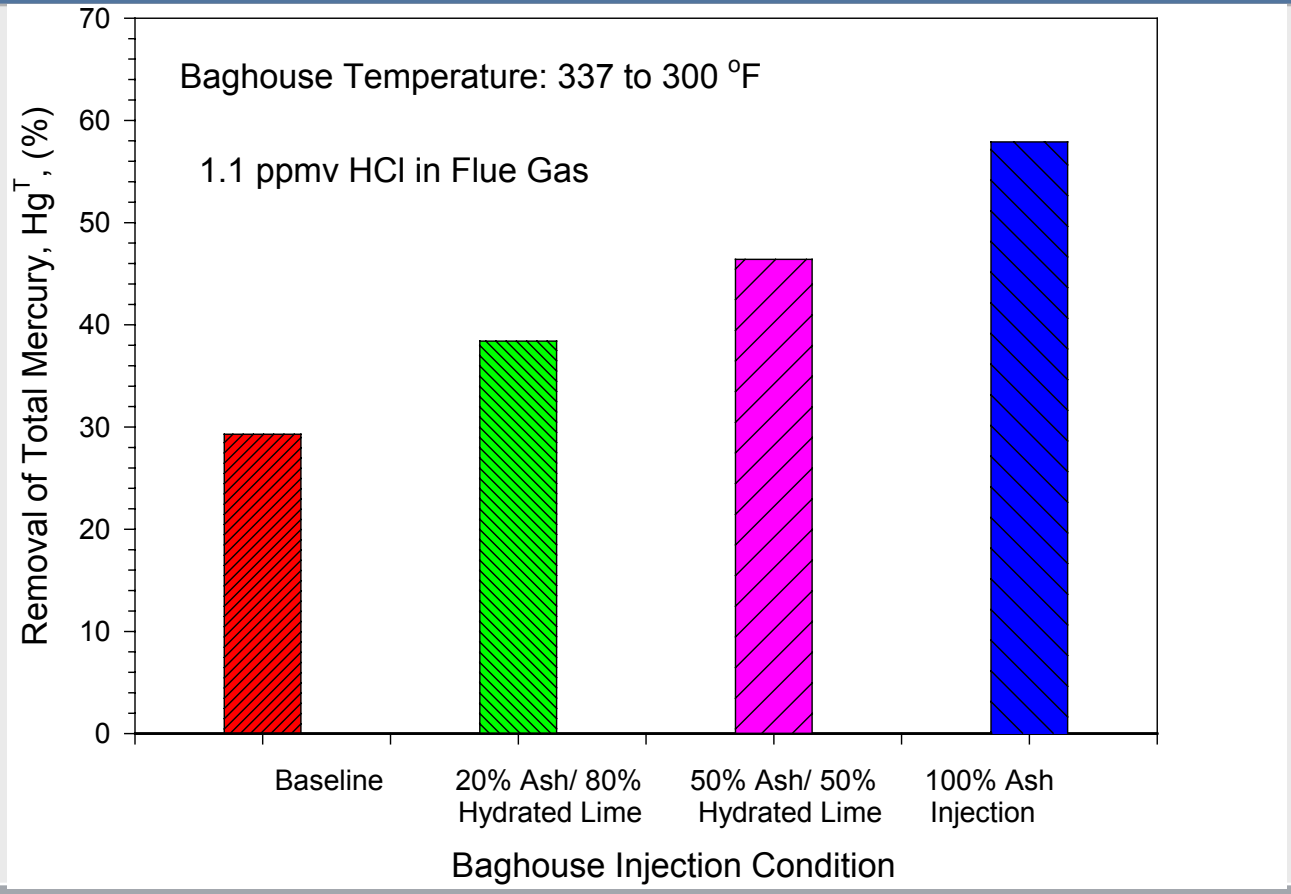
Analysis of Choctaw America Coal Ash Injected into Baghouse

Mineral Analysis		Other Properties	
% Li_2O	0.06		
% Na_2O	1.4	LOI	4.2 %
% K_2O	2.0		
% MgO	1.2	UBC	3.51 %
% CaO	3.9		
% Fe_2O_3	12.4	meso-pore	
% Al_2O_3	33.0	N_2-BET	2.32 m^2/g
% SiO_2	43.1	Surface Area	
% TiO_2	1.8	*PRB Ash*	*PRB Ash*
% P_2O_5	0.38	*Surface Area*	*2.02 m^2/g*
% SO_3	0.53		

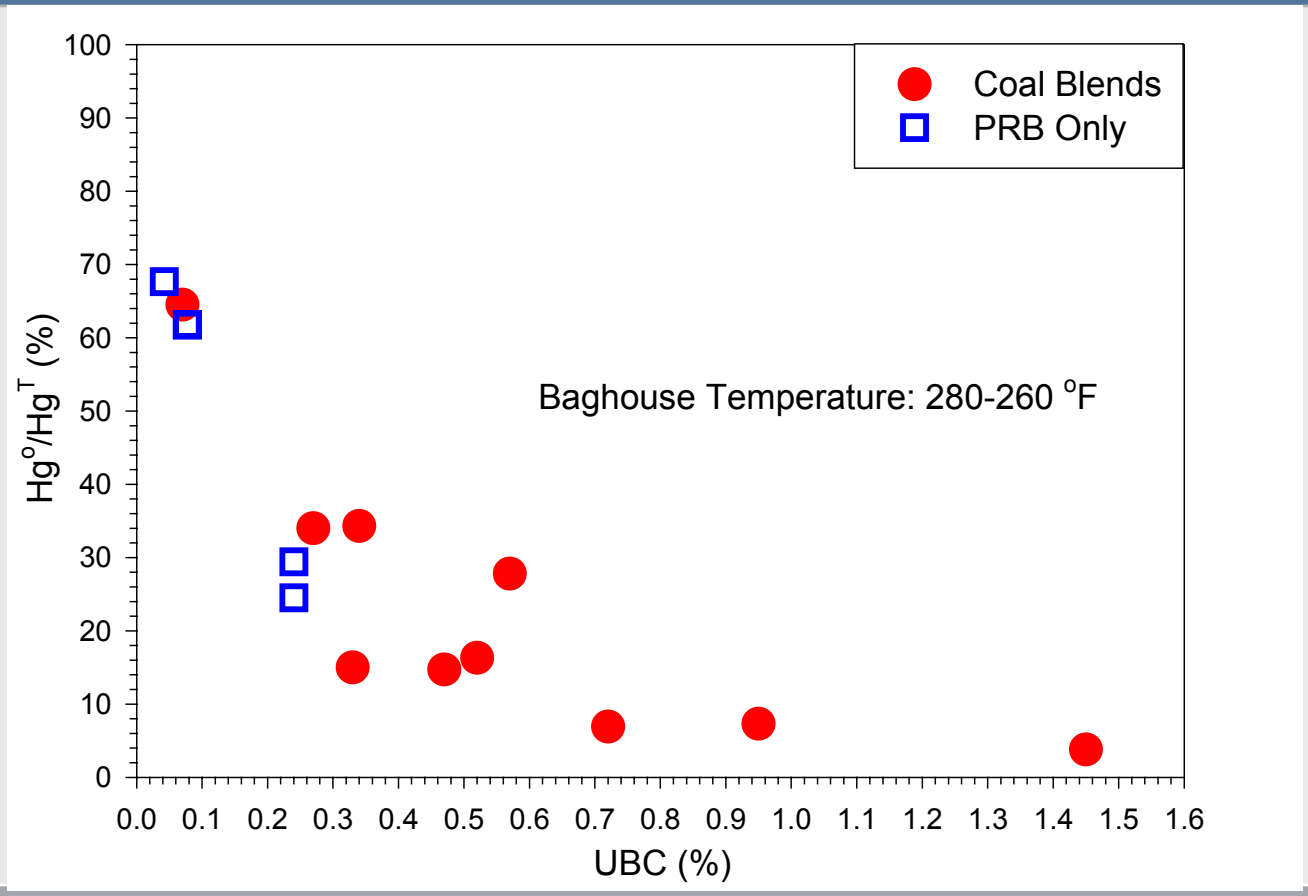
Hg-Oxidation While Injecting Ash and Hydrated Lime Directly into Baghouse



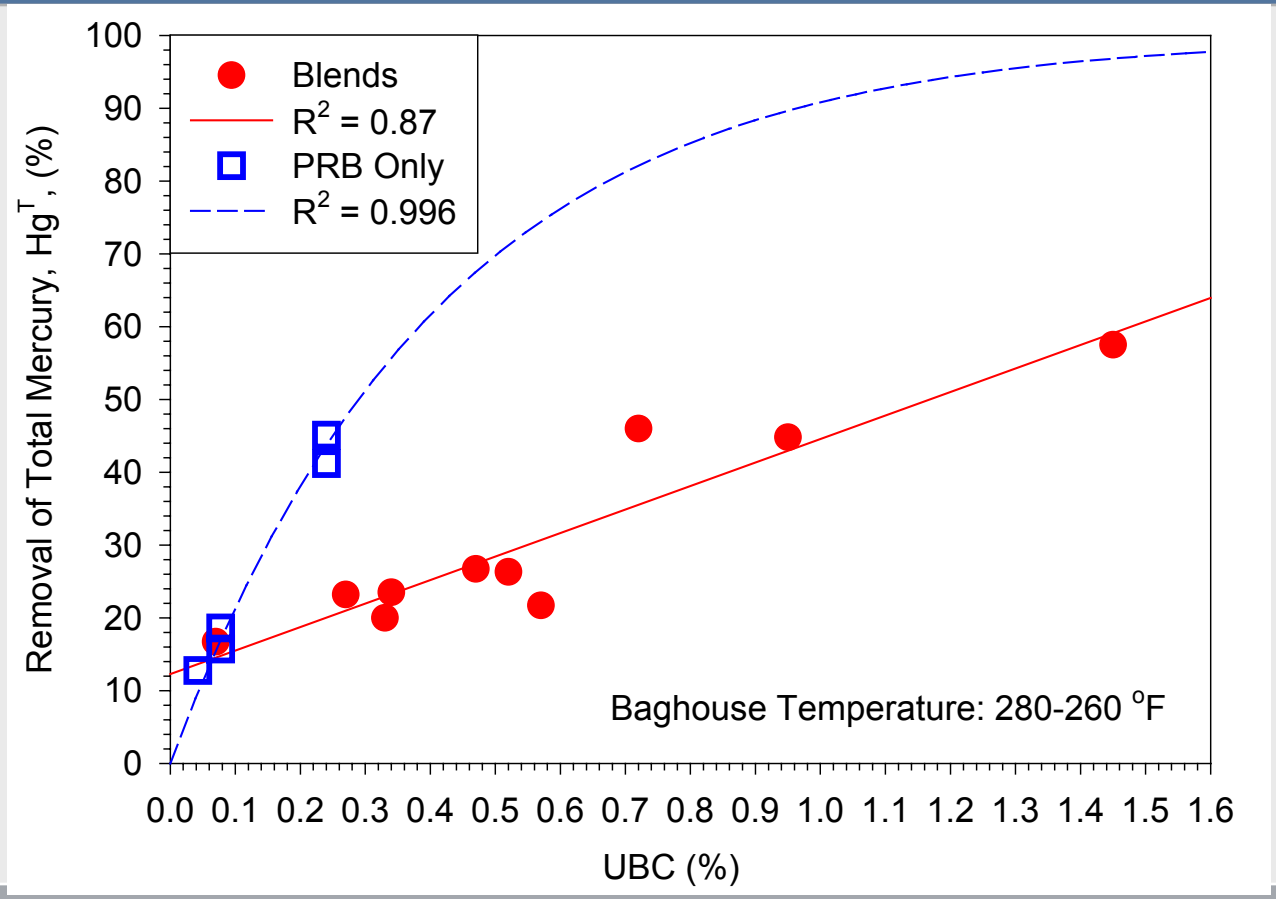
Hg-Removal While Injecting Ash and Hydrated Lime Directly into Baghouse



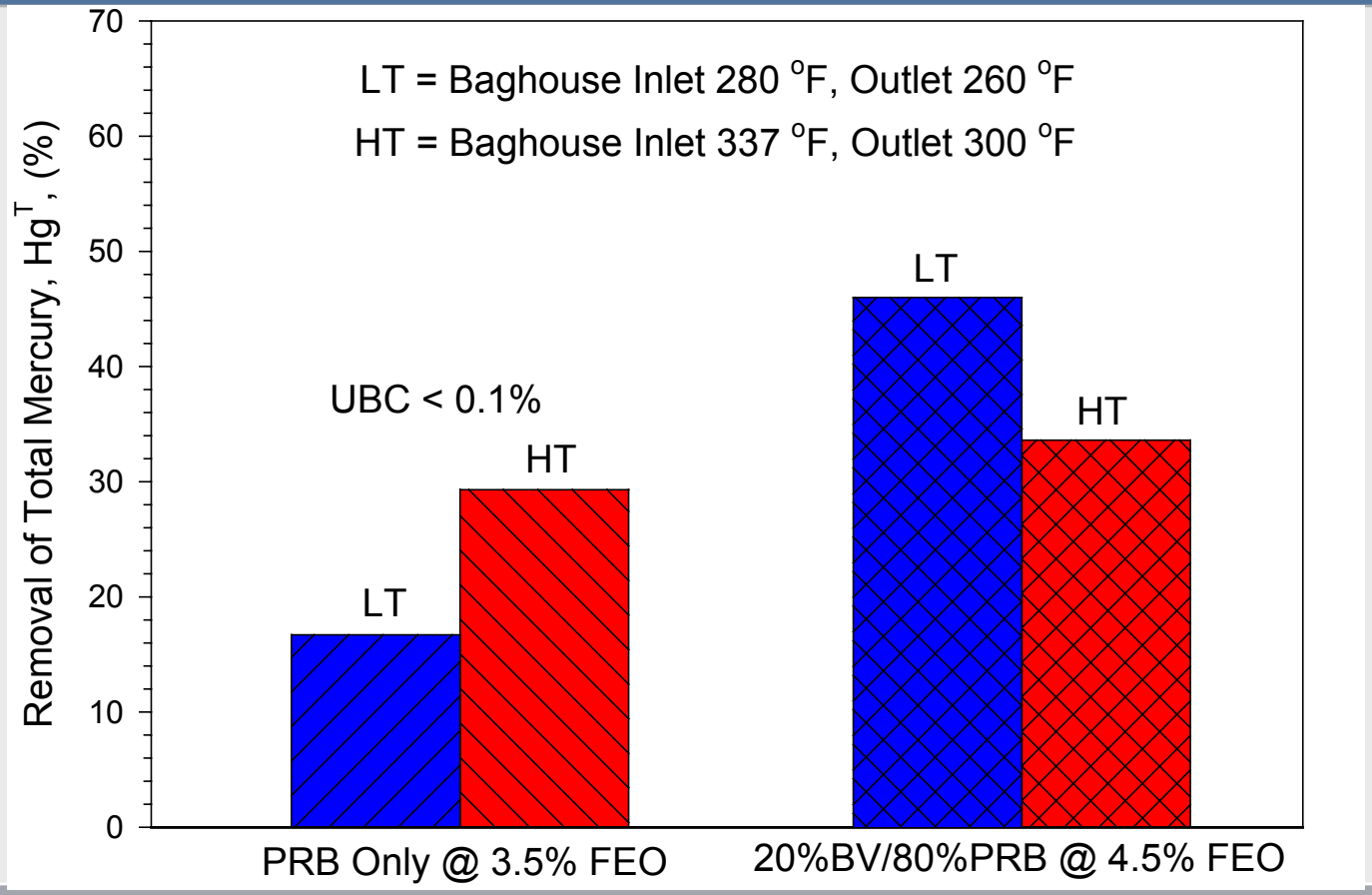
ANSWER: Unburned Carbon



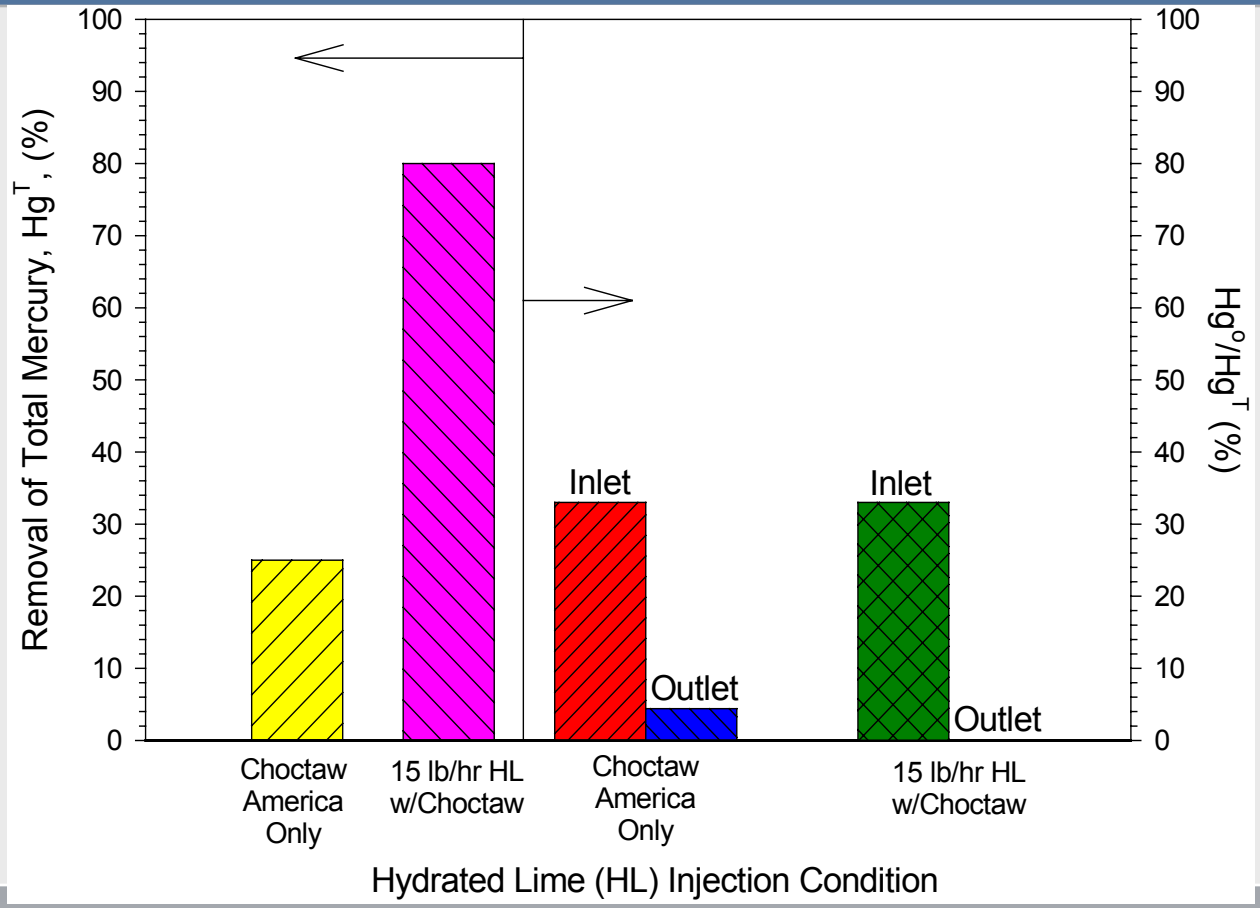
UBC Enhances Hg^o & $HgCl_2$ Capture by Calcium in PRB Flyash



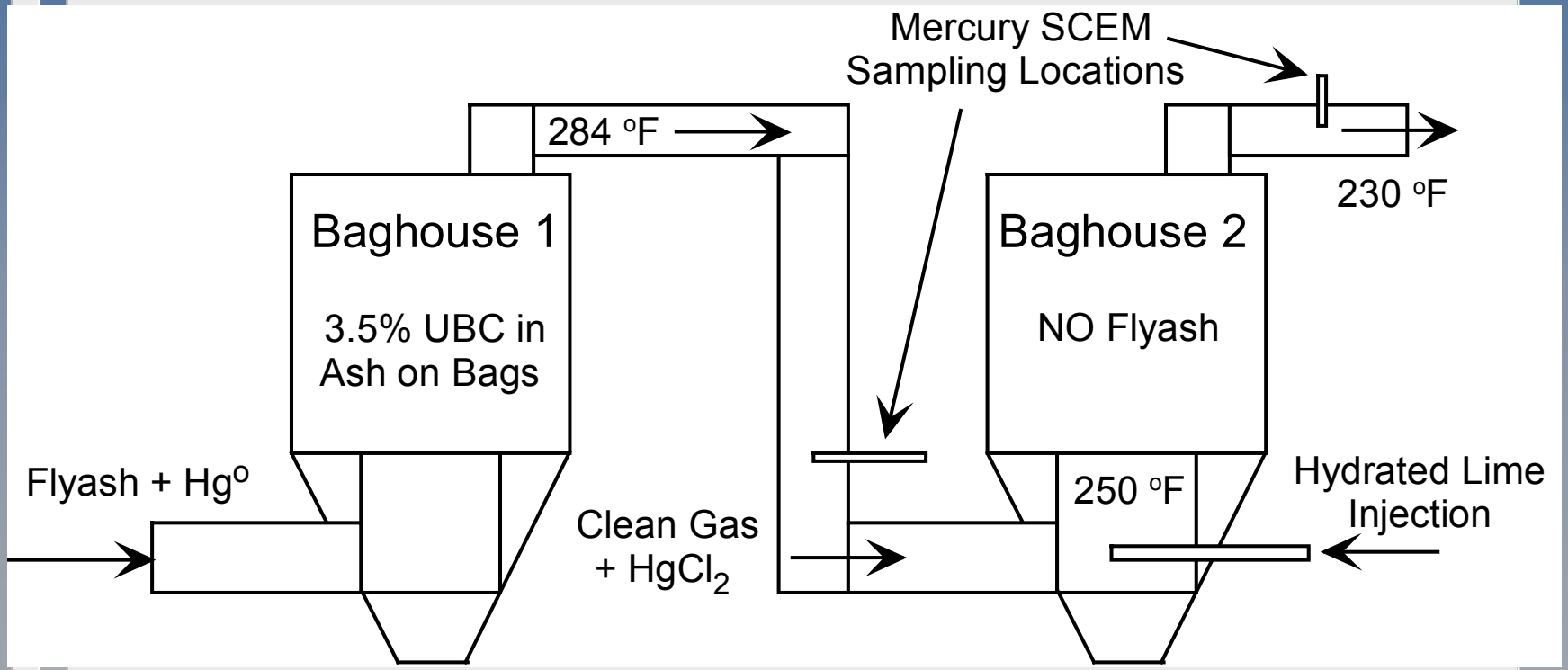
Temperature Dependence Changes with Mechanism



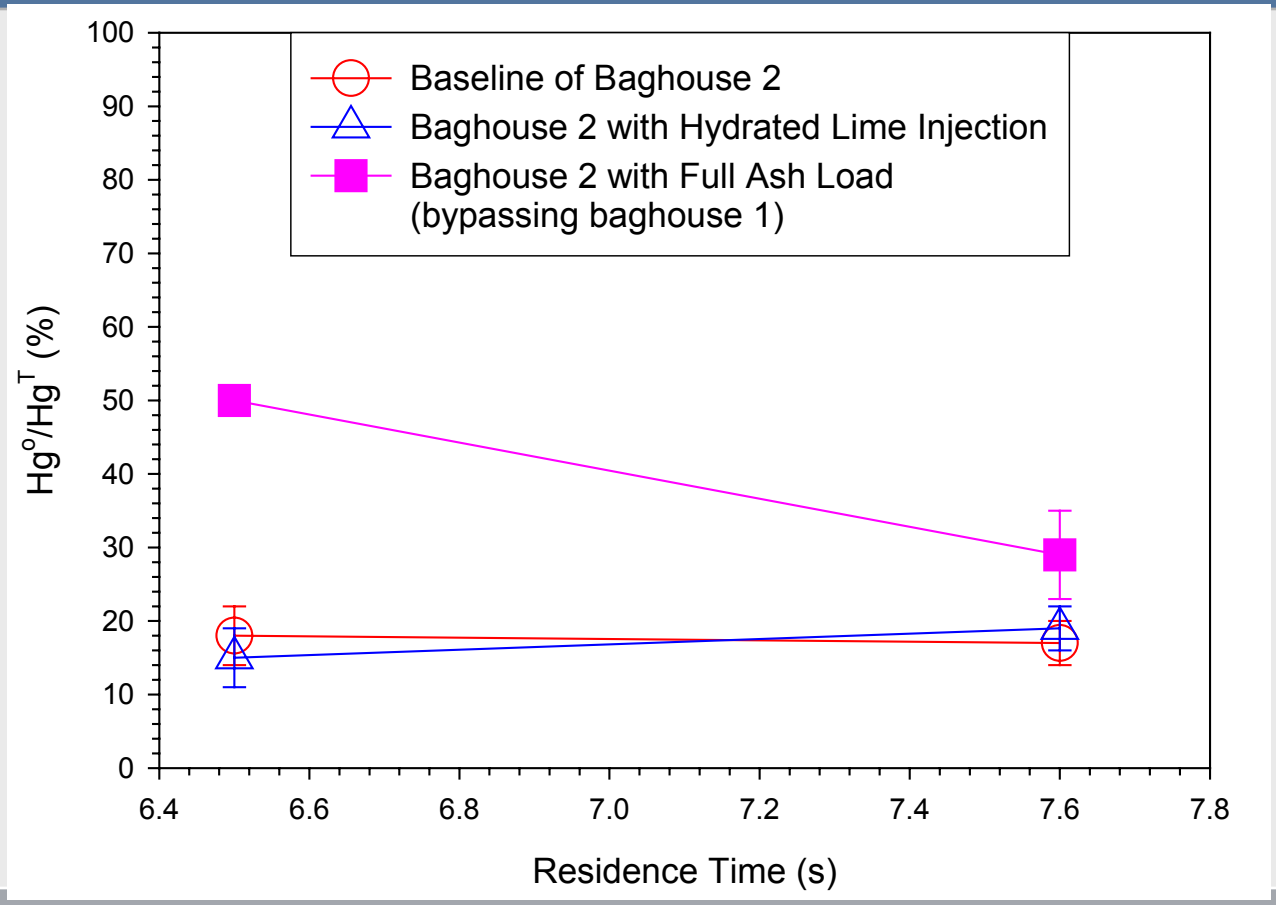
Hydrated Lime w/Catalyst is Effective



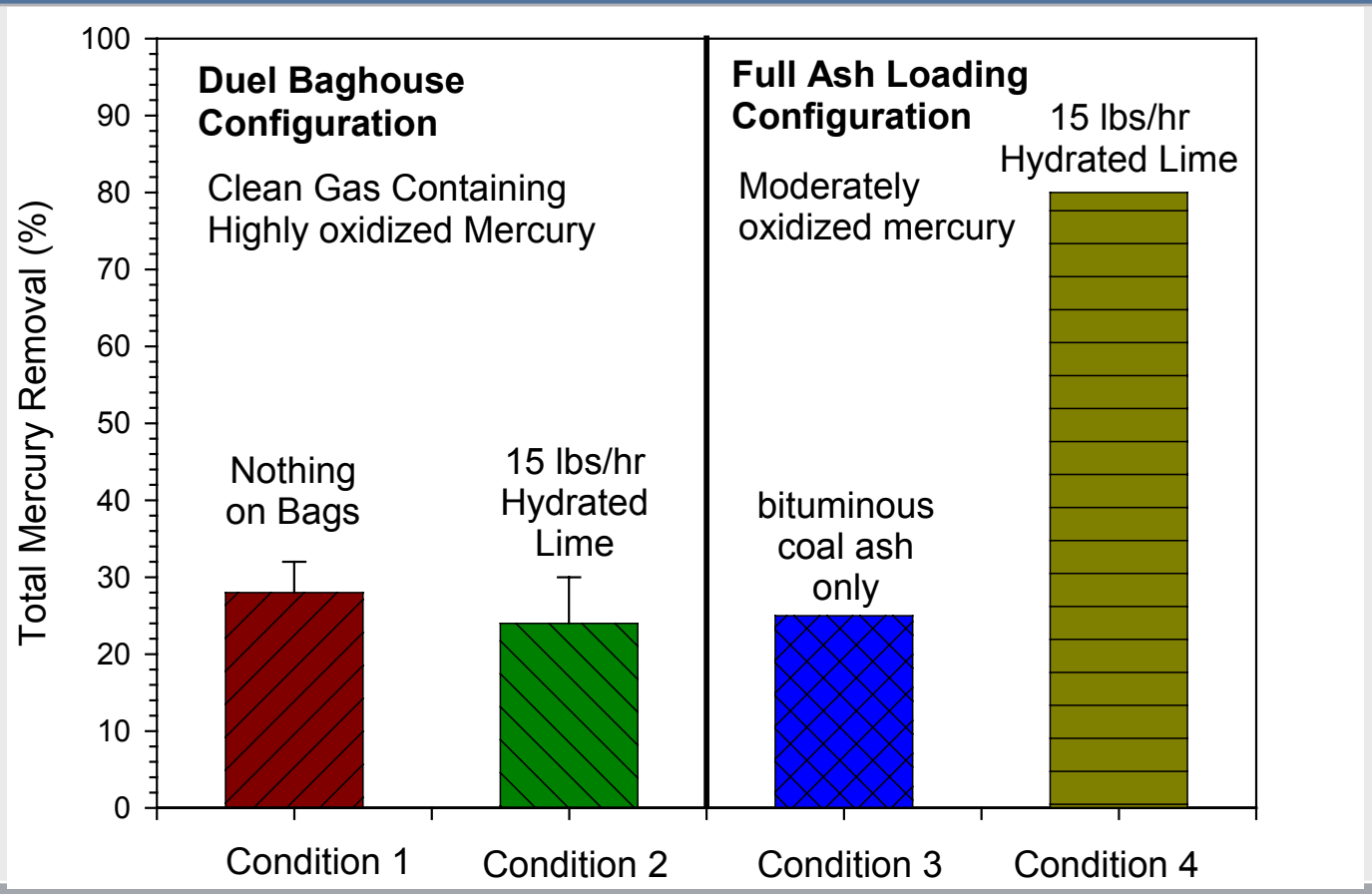
Dual-Baghouse Configuration



Mercury Oxidation is NOT Enough



UBC is Needed to Catalyze Hg-Capture on the Calcium



UBC Mechanism for Enhancing Hg-Oxidation

- UBC + HCl <=> UBC.Cl + H
- UBC.Cl + Hg^o <=> UBC + HgCl
- UBC.Cl + HgCl <=> UBC + HgCl2

UBC Mechanism for Enhancing Hg-Capture on Calcium

- $UBC.Cl + Hg^{o} <=> UBC.HgCl$
- $UBC + HgCl_2 <=> UBC.HgCl_2$
- $UBC.HgCl + Ca <=> Products$
- $UBC.HgCl_2 + Ca <=> Products$

Conclusions

- FOR LOW UBC CONDITIONS
- Total chorine content tends to increase Hg-oxidation across the baghouse.
- Catalytic material in coal ash is more important in determining Hg-oxidation and removal than total chlorine content.
- Total chorine content has little effect on total Hg-removal.
- The primary parameter responsible for enhancement of Hg-oxidation for blends of PRB and bituminous coal is the UBC in bituminous ash.
- Hydrated lime and even high-calcium ashes such as PRB can be effective sorbents, if they are mixed with a catalyst.

Conclusions -- continued

FOR LOW UBC CONDITIONS

The primary parameter responsible for enhancement of Hg-capture for the blends of PRB and bituminous coal in this investigation was the UBC in bituminous ash.

Most effective Hg-removal was observed for high-calcium and high UBC concentrations in the ash.

UBC catalytically enhances *both* Hg^o and $HgCl_2$ capture by Ca.