Demonstration of an Integrated Approach to Mercury Control at Lee Station

Preliminary Results

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Program description

Program participants

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- Progress Energy – Peter Hoeflich, Daniel Donochod, Garry Moore
- U.S. DOE – Lynn Brickett
- DOE Contract No. DE-FC26-05NT42310

Project Objectives:

(1) Demonstrate 70% mercury control from current emissions
  - the enhancement of “naturally” occurring Hg capture by fly ash
  - duct humidification to lower ESP temperature
  - ACI upstream of the ESP

(2) Minimize activated carbon injection rate

(3) Determine effect of SO_3 on sorbent performance

Program description

- Lee station Unit 3
- Located near Goldsboro, NC
- 250 MW opposed-wall fired
- E. Bituminous coal
- SO_3 conditioning system

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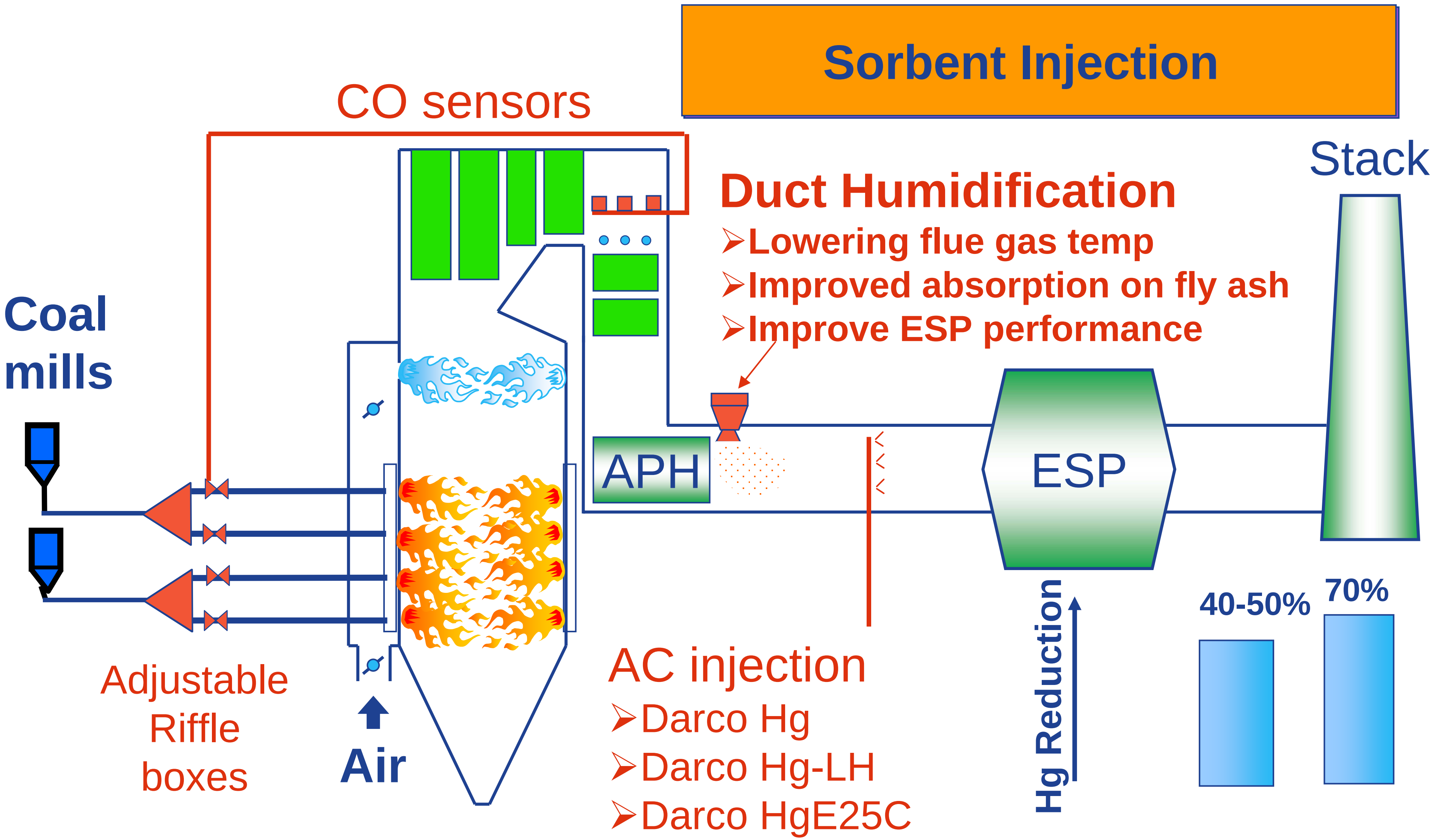
Program components

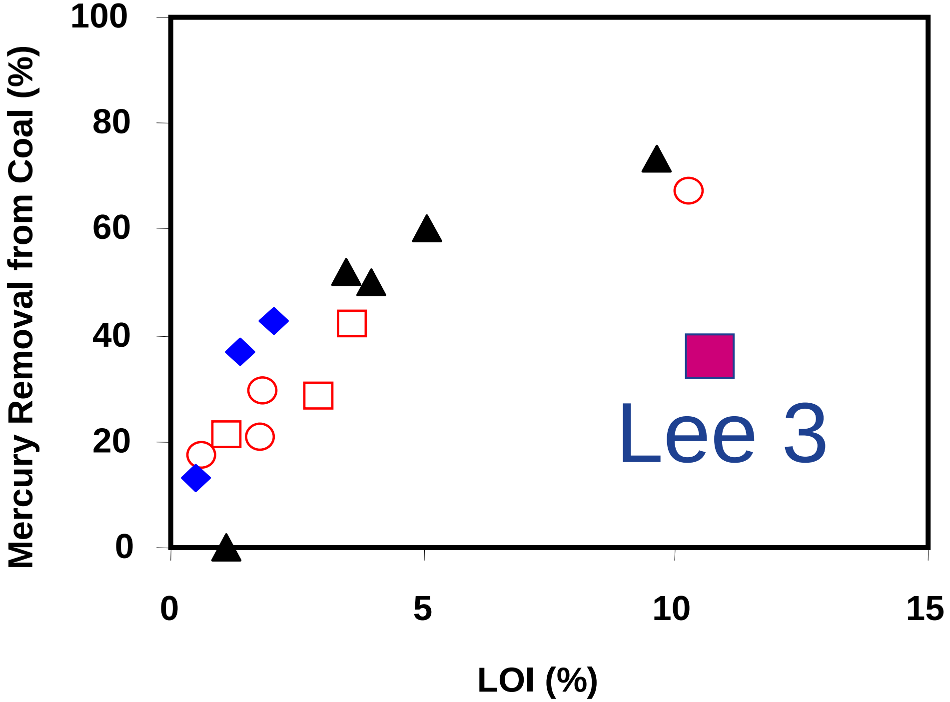


Program status

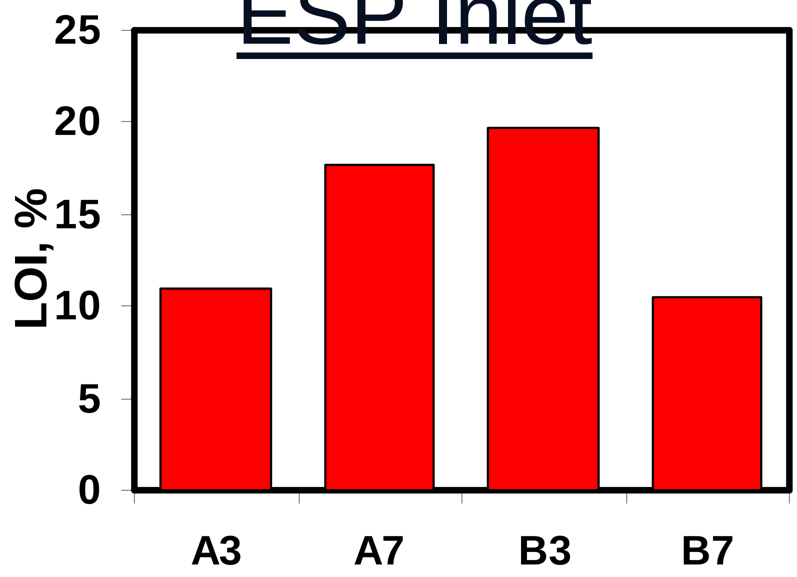
- Combustion optimization – Dec 2005- Jan 2006
- Sorbent optimization – Aug 2006
- 30-day sorbent injection Aug - Sept 2006
- Data reduction in progress

Effect of LOI on mercury reduction

Pilot-Scale Data



Lee 3 LOI distribution across ESP Inlet



Potential to improve "native" mercury removal

Combustion optimization

Activities

- Balancing coal flow
  - Adjustable riffle boxes – Foster Wheeler
  - Rotoprobe coal flow measurements
- Optimizing burners and SOFA
  - Minimizing excess O_2
  - Temporarily CO/O_2 grid

Expected Results

- More uniform LOI distribution
- Improvement in “native” mercury reduction on fly ash
- Reduction in NO_x emissions

CO/O_2 distribution in boiler backpass

Before Combustion Optimization

	O2	NOx	CO
Average	3.04	311	38.5
St Dev	0.70	25	39.2
Variation	22.9%	8.0%	101.9%

After Combustion optimization

	O2	NOx	CO
Average	2.63	257	157.7
St Dev	0.31	25	186.9
Variation	11.9%	9.8%	118.5%

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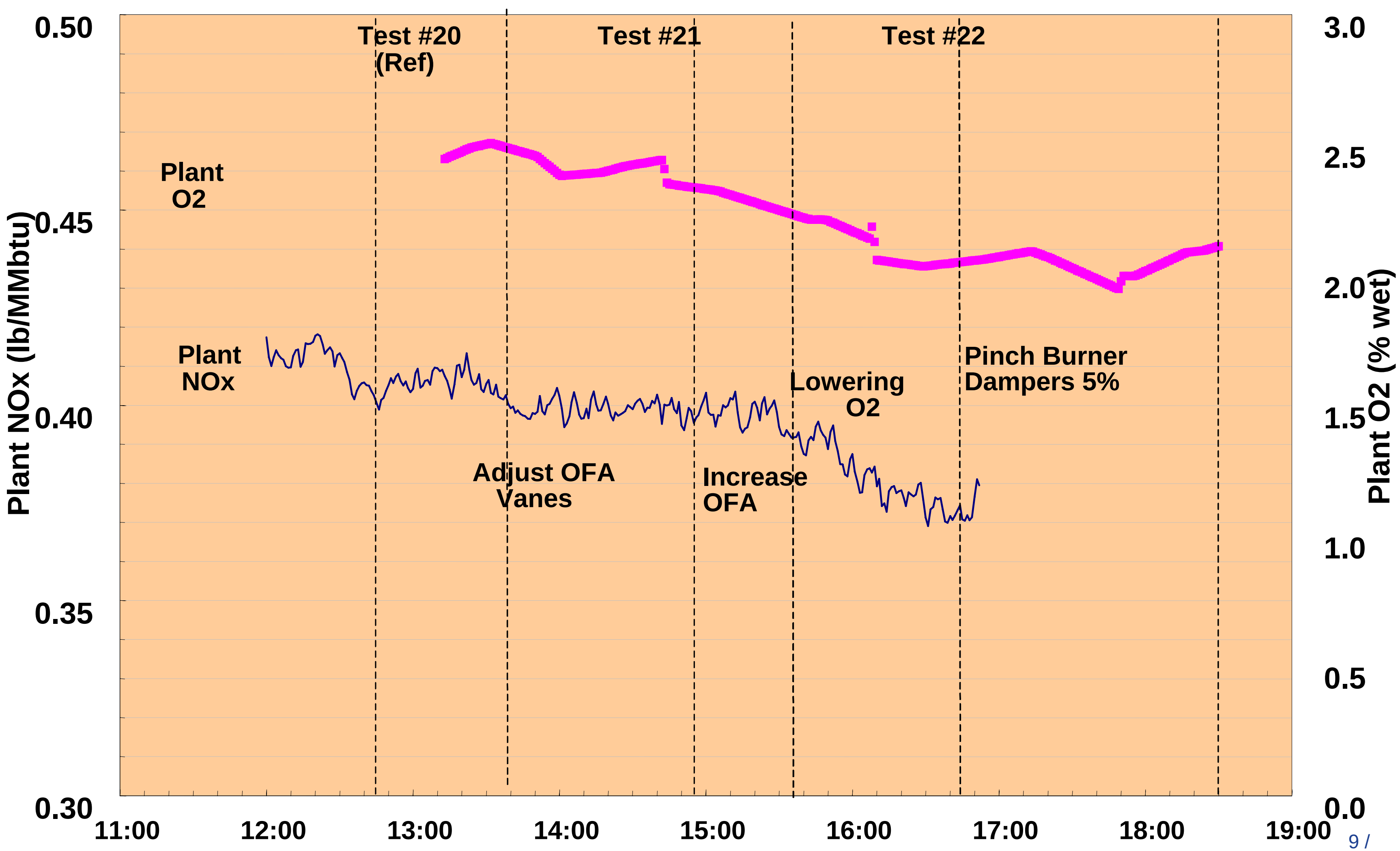
Effect of combustion conditions



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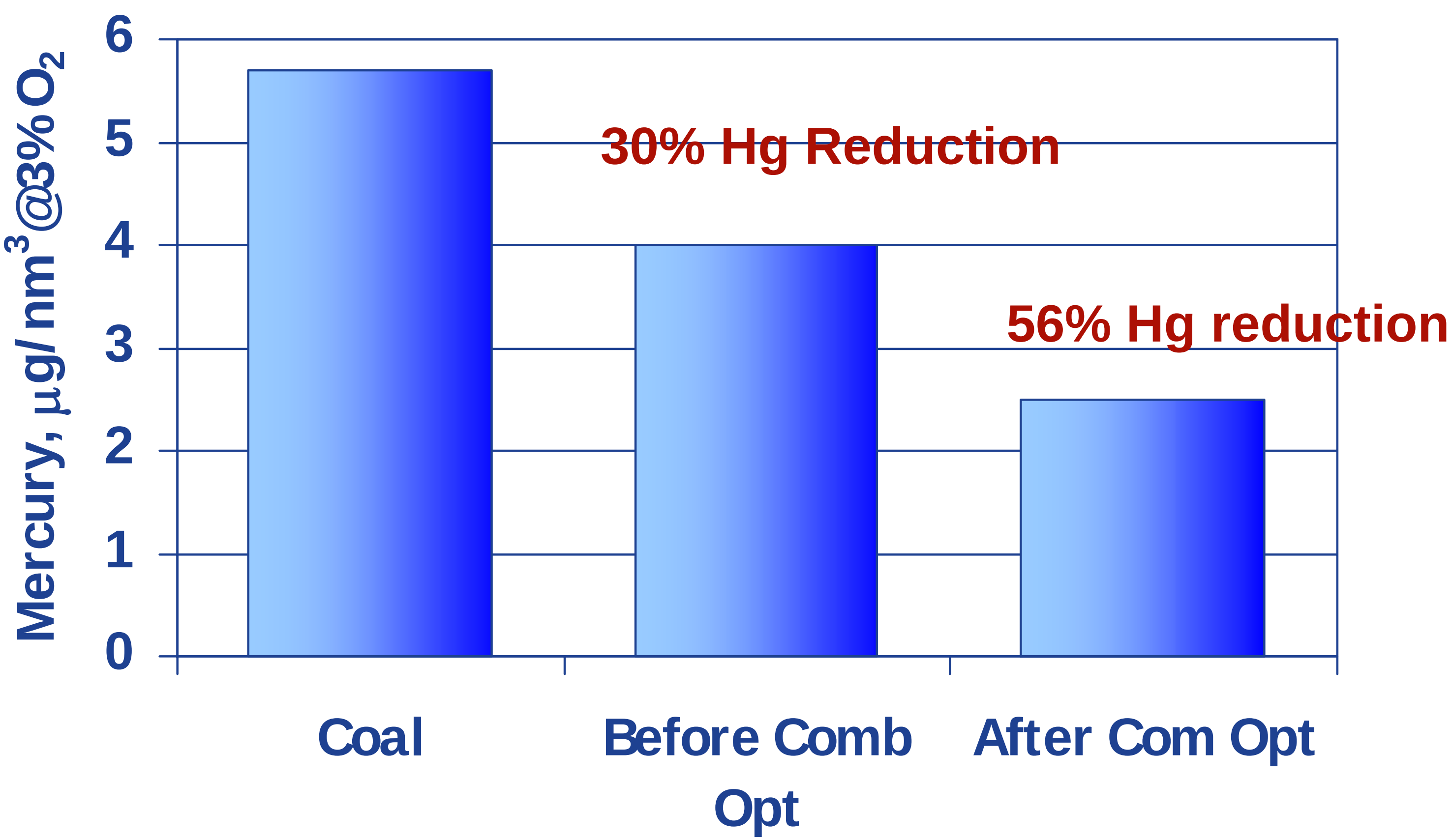
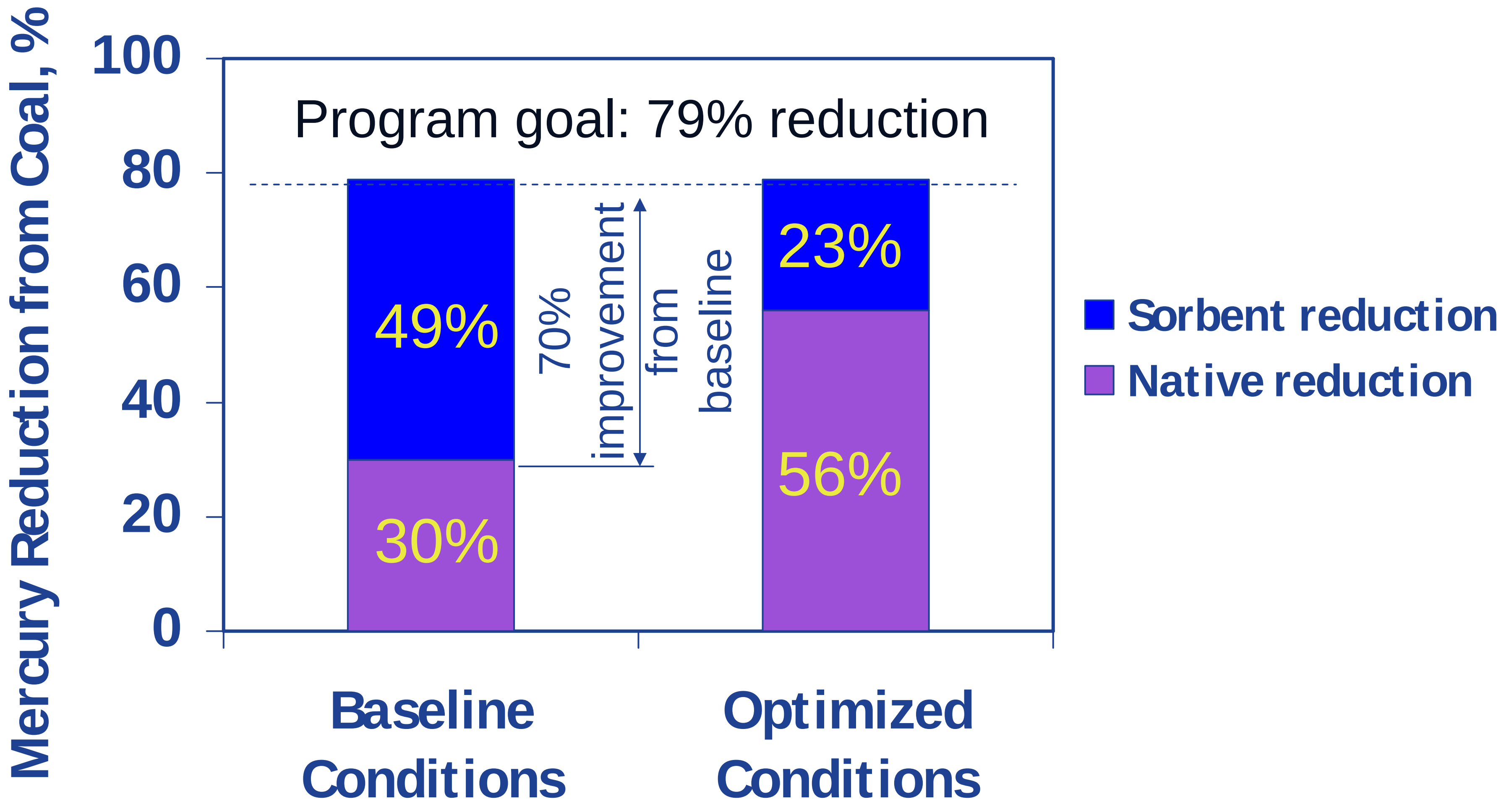
Combustion optimization

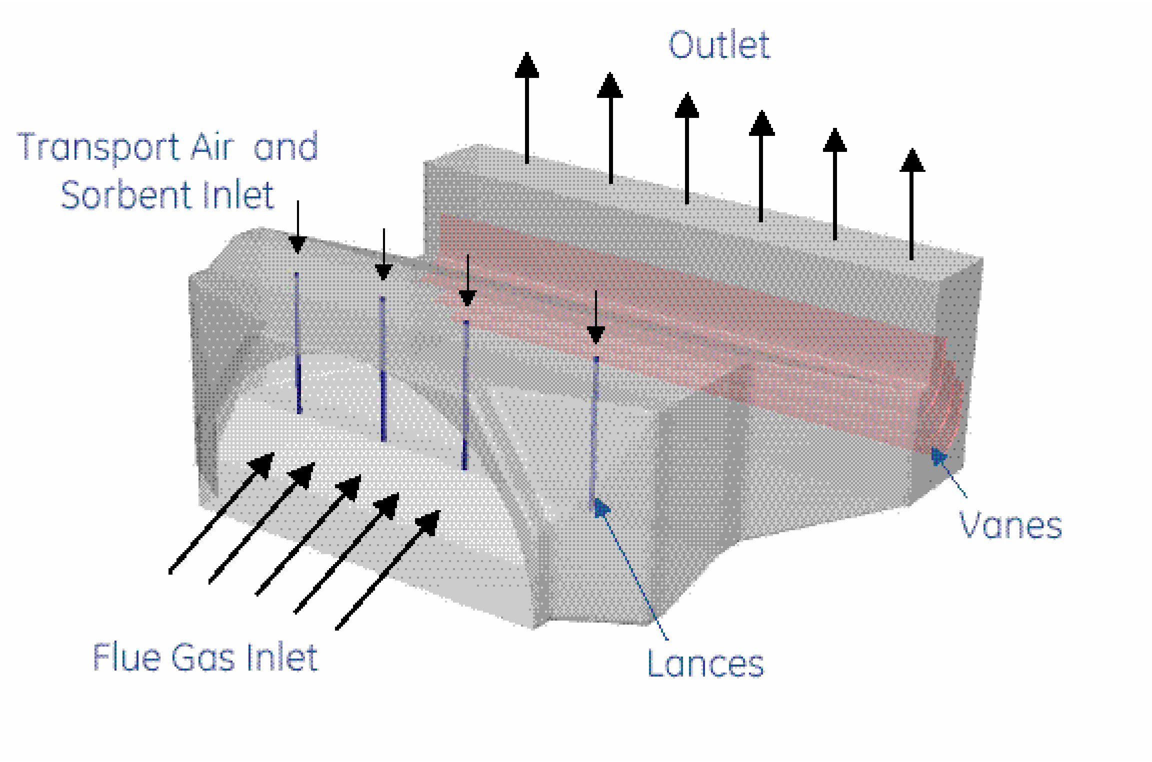


- 38% improvement in comparison with pre Combustion Optimization mercury reduction
- NO_x reduced by 18%

Sorbent injection strategy



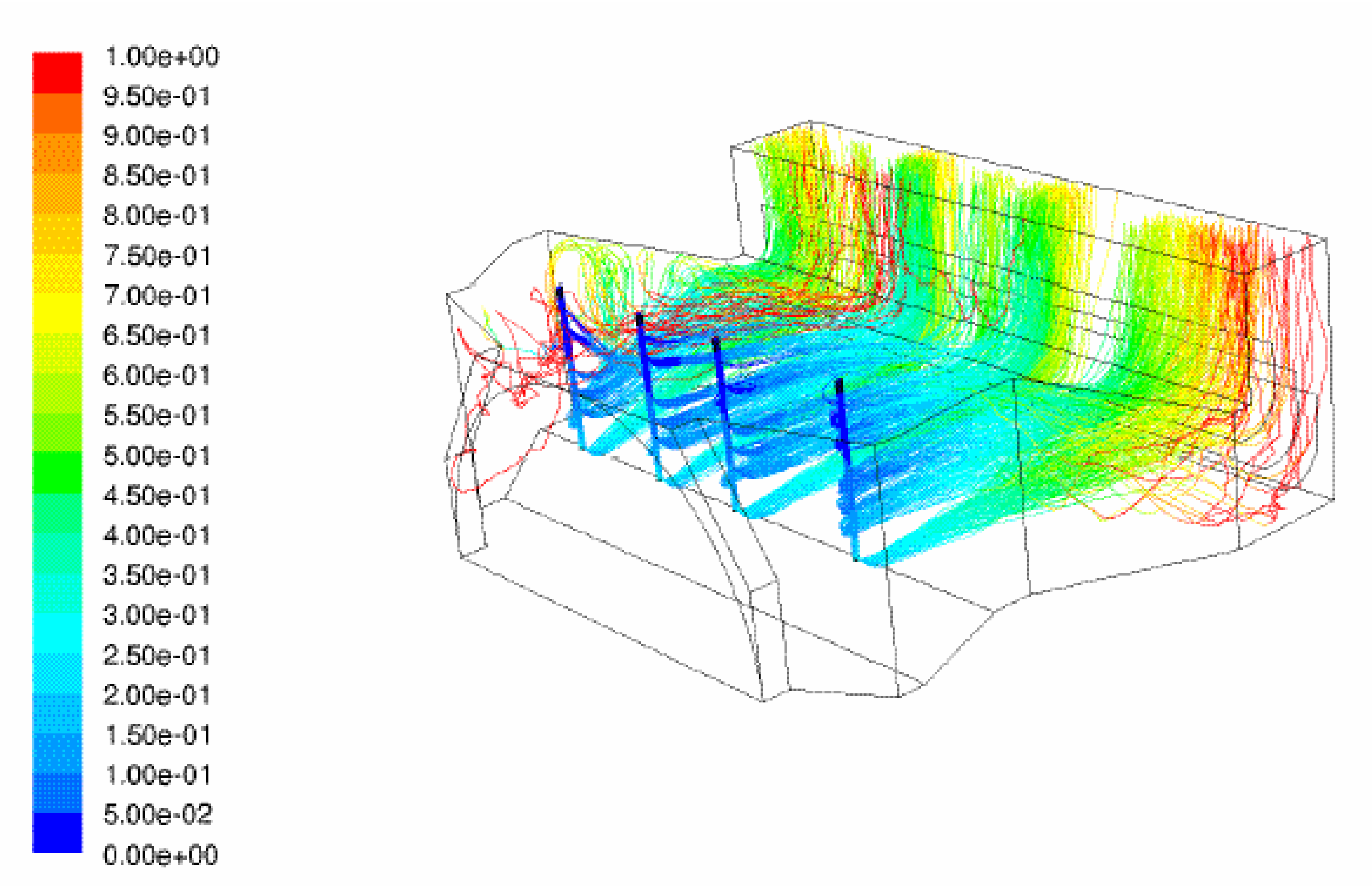
CFD modeling



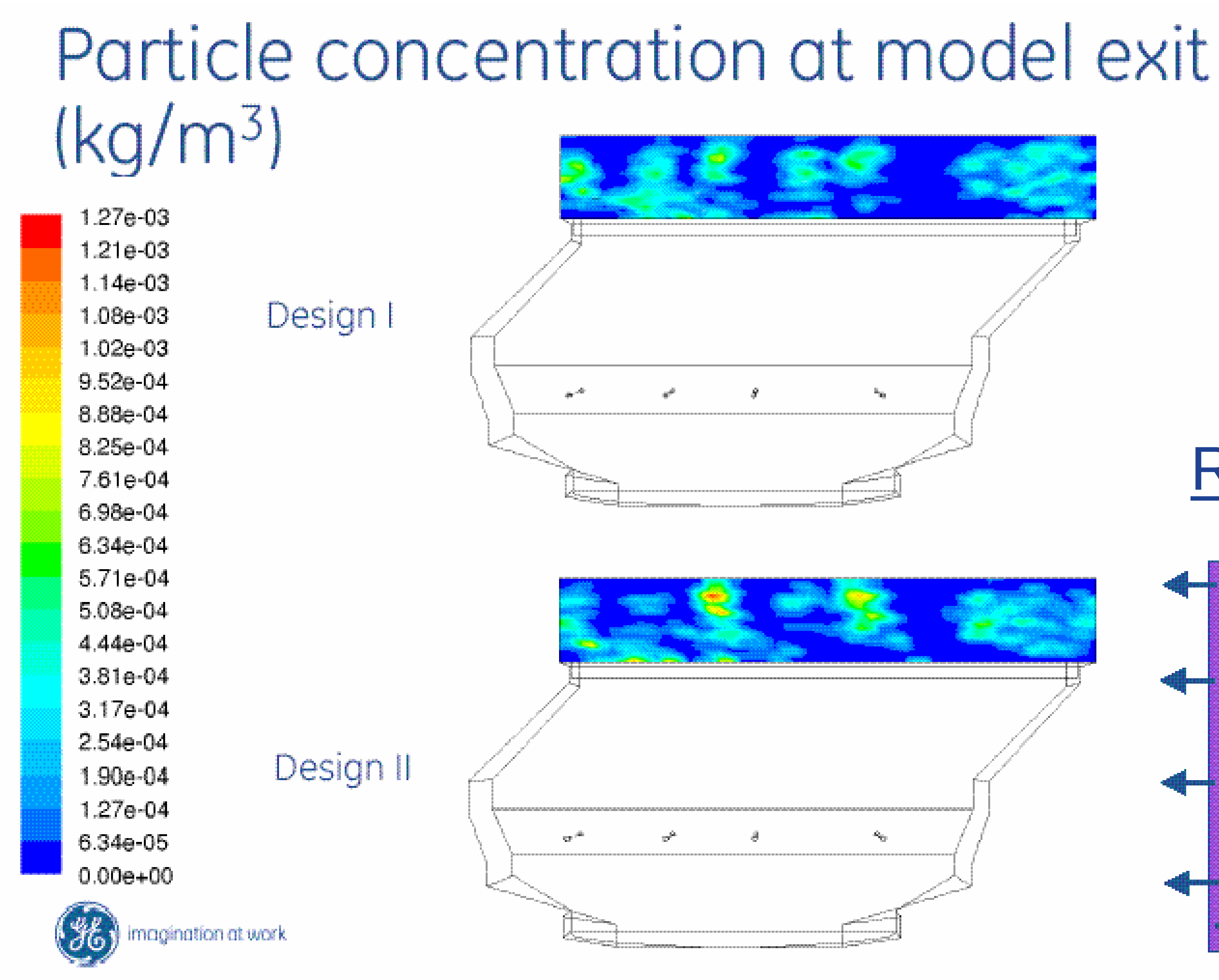
- Characterize flow
- Obtain temperature distribution
- Determine optimum design of lances

Sorbent trajectories

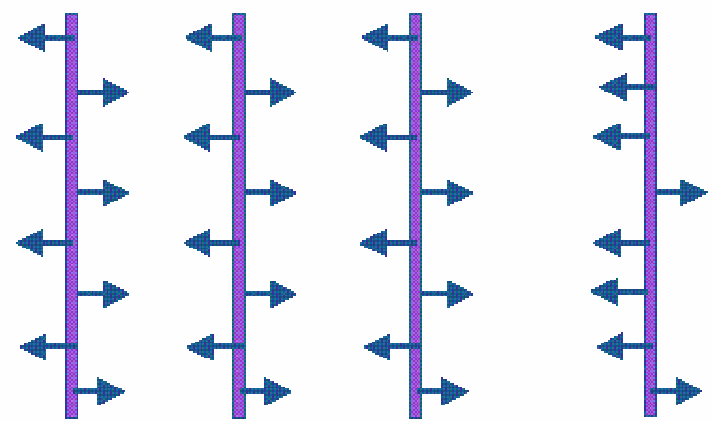
Colored by residence time



Lances design



Recommended Design



Sorbent injection system

- 250 cf daily silo
- 40,000 lb bulk trailer
- Bulk bag un-loader

Apogee Scientific provided mercury measurements

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Sorbent injection ports

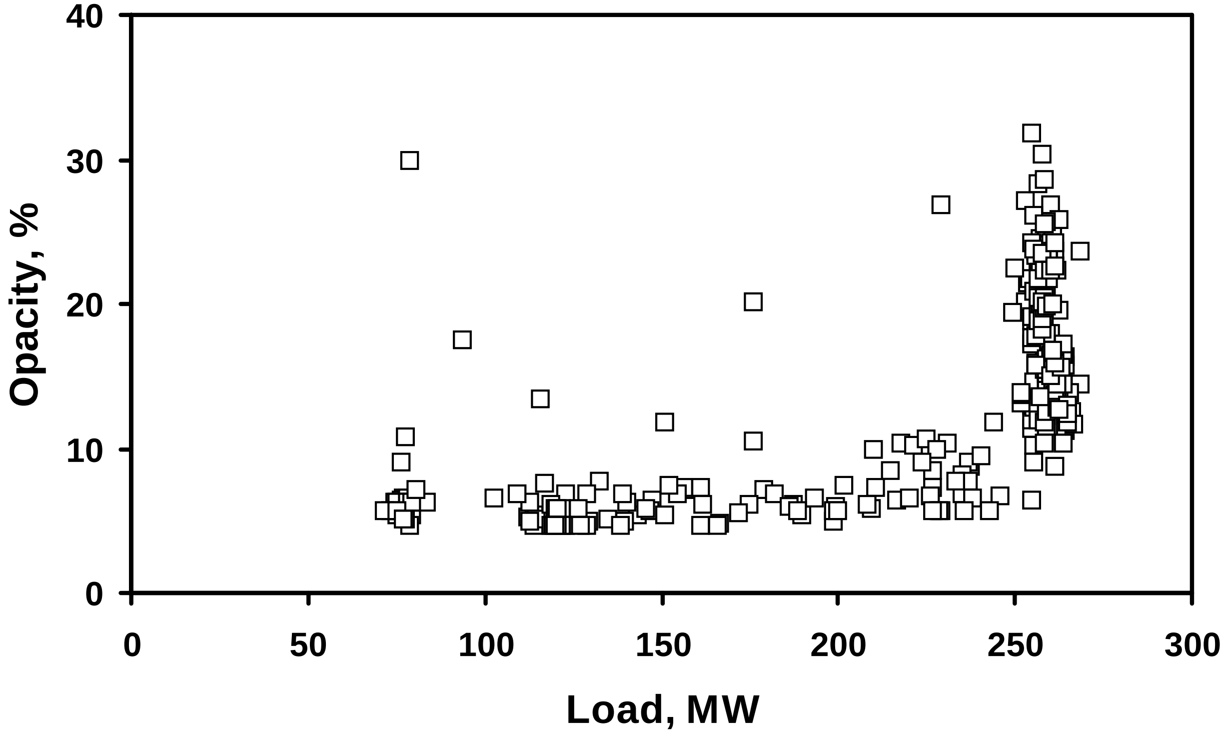
ESP

Ports

Air heater

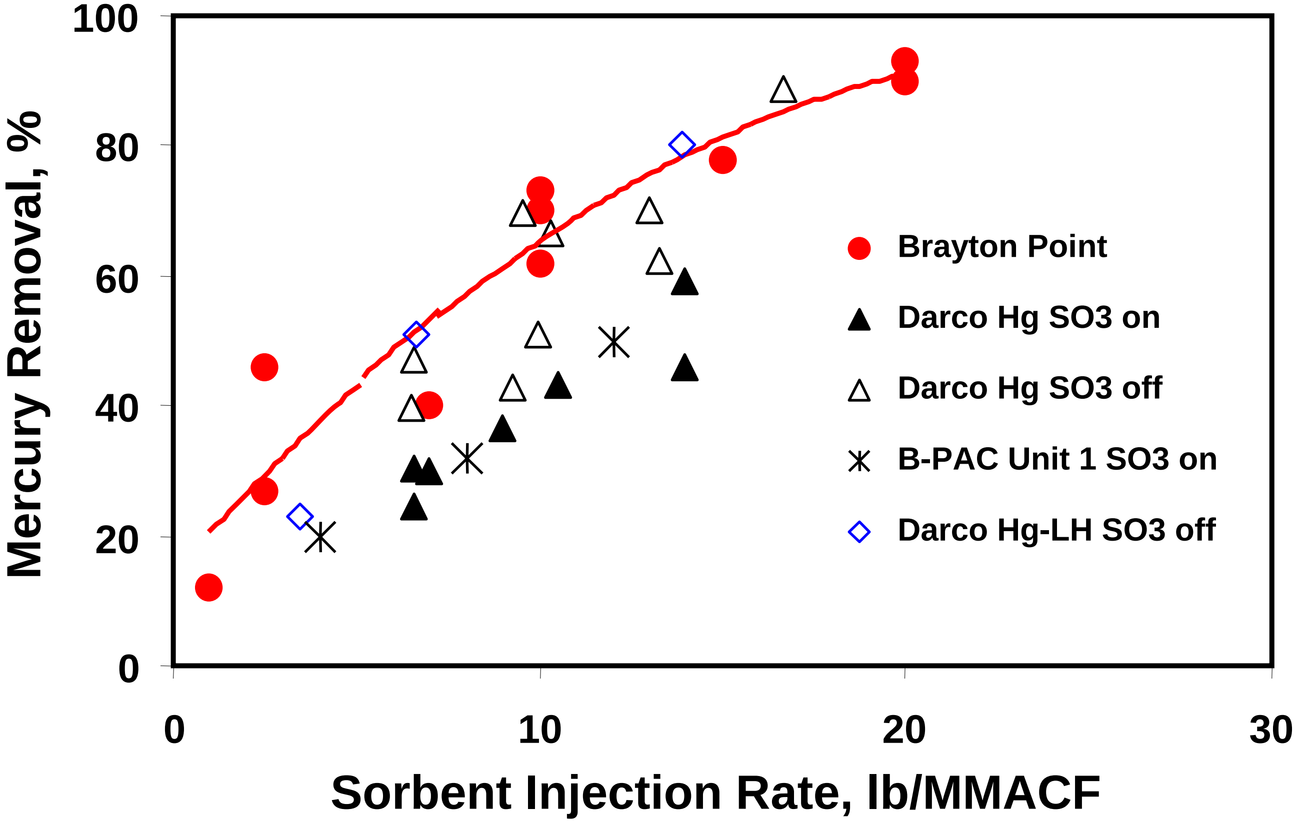
SO_3 injection

Lee 3 load and opacity



- Opacity increases at full load
- SO_3 injection is usually operational at full load

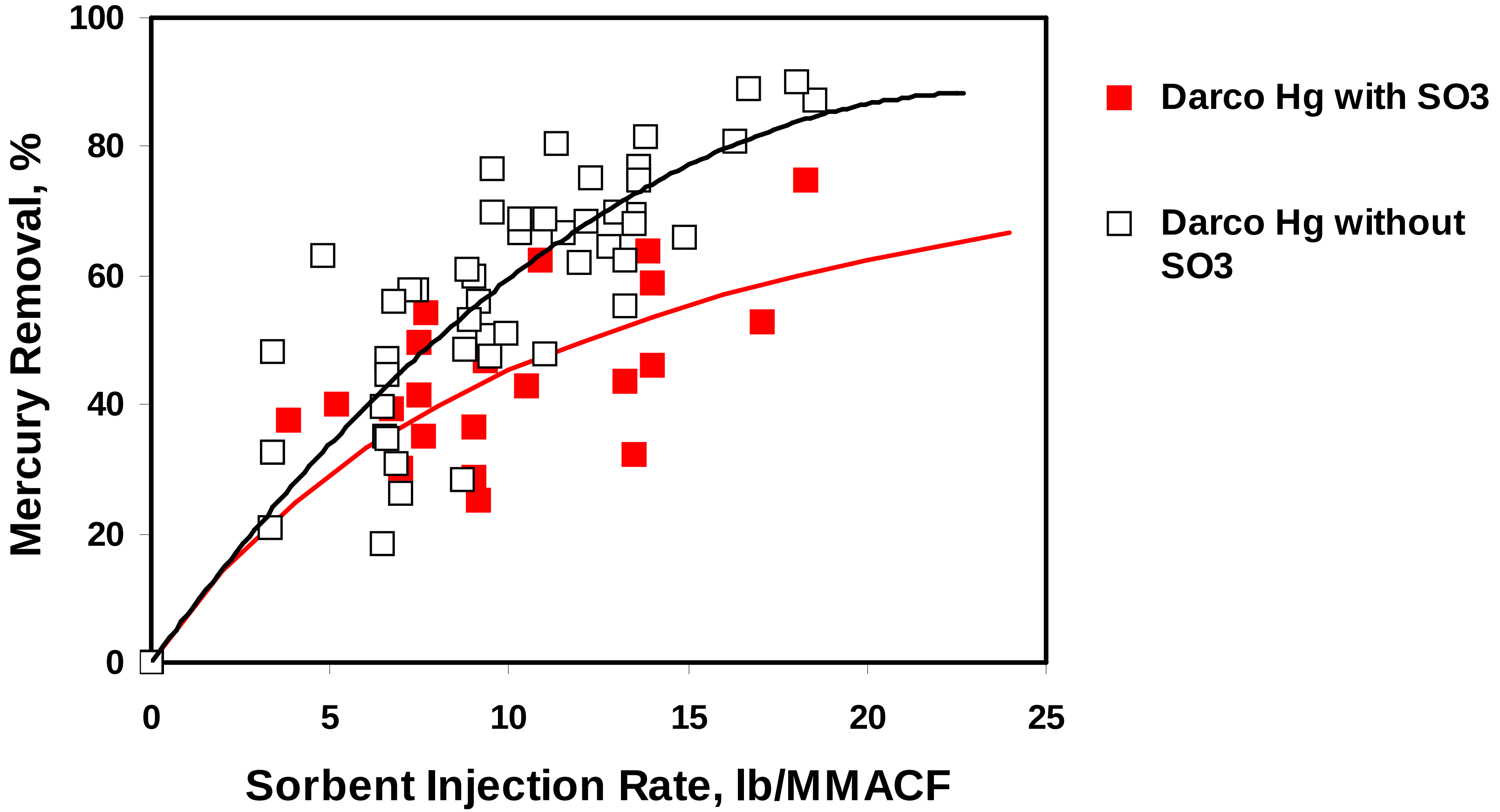
Sorbent optimization



- Darco Hg
- Darco Hg-LH

- Darco Hg and Darco Hg-LH showed similar performances
- 40-50% higher sorbent injection rate in the presence of SO_3

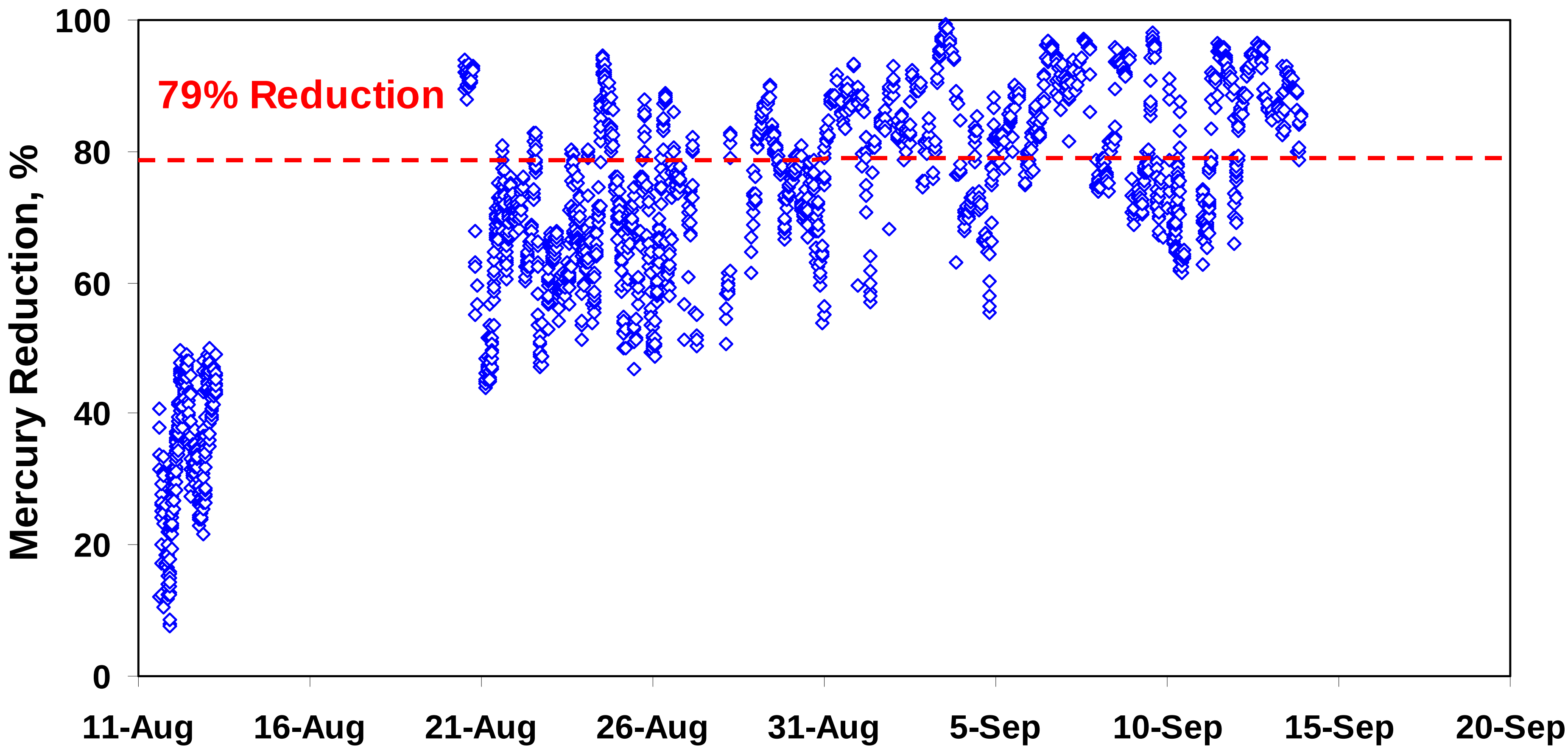
Darco Hg injection – 30-day trial



Negative effect of SO_3 injection on sorbent performanc

Mercury reduction

Preliminary data



Average sorbent injection rate:

- without SO_3 – 10 lb/MMACF
- with SO_3 – 15 lb/MMACF

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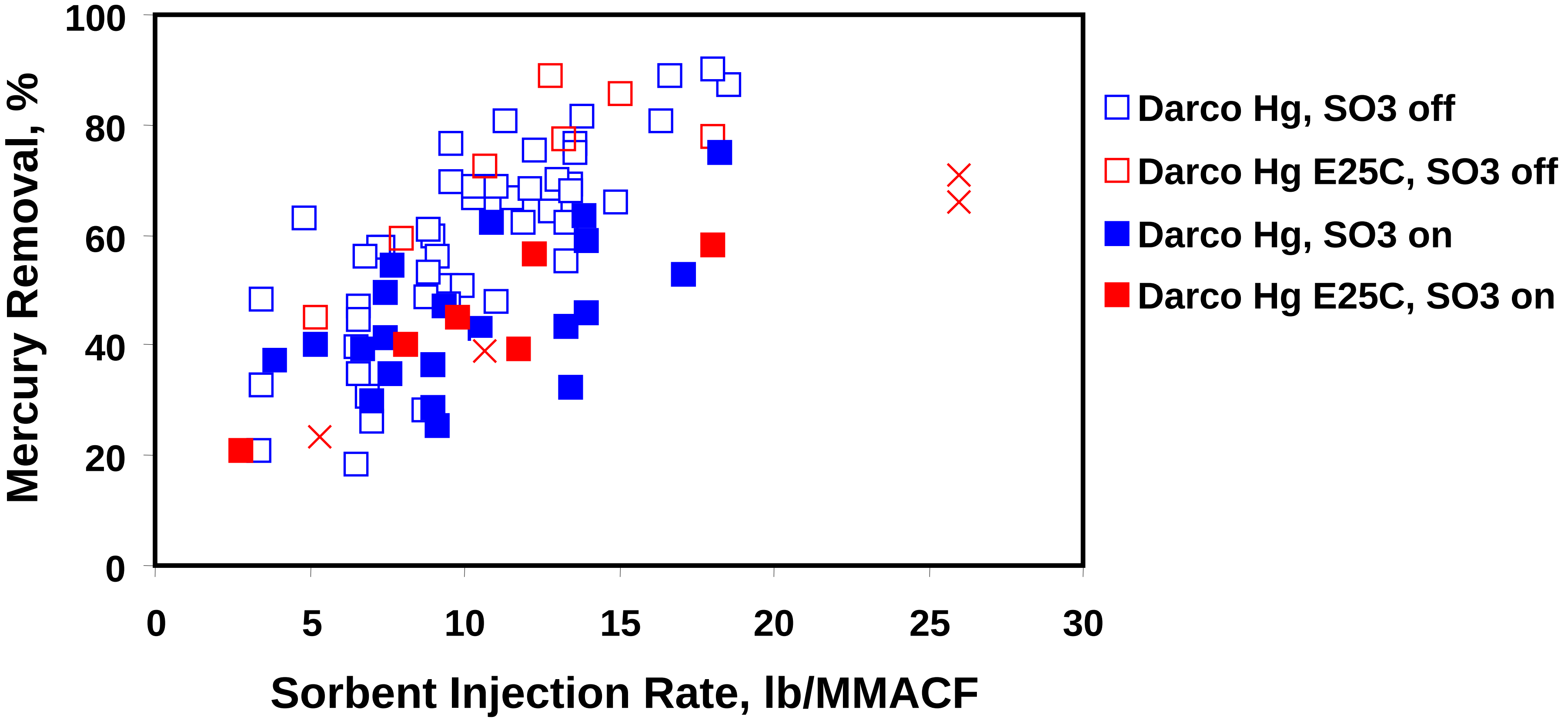
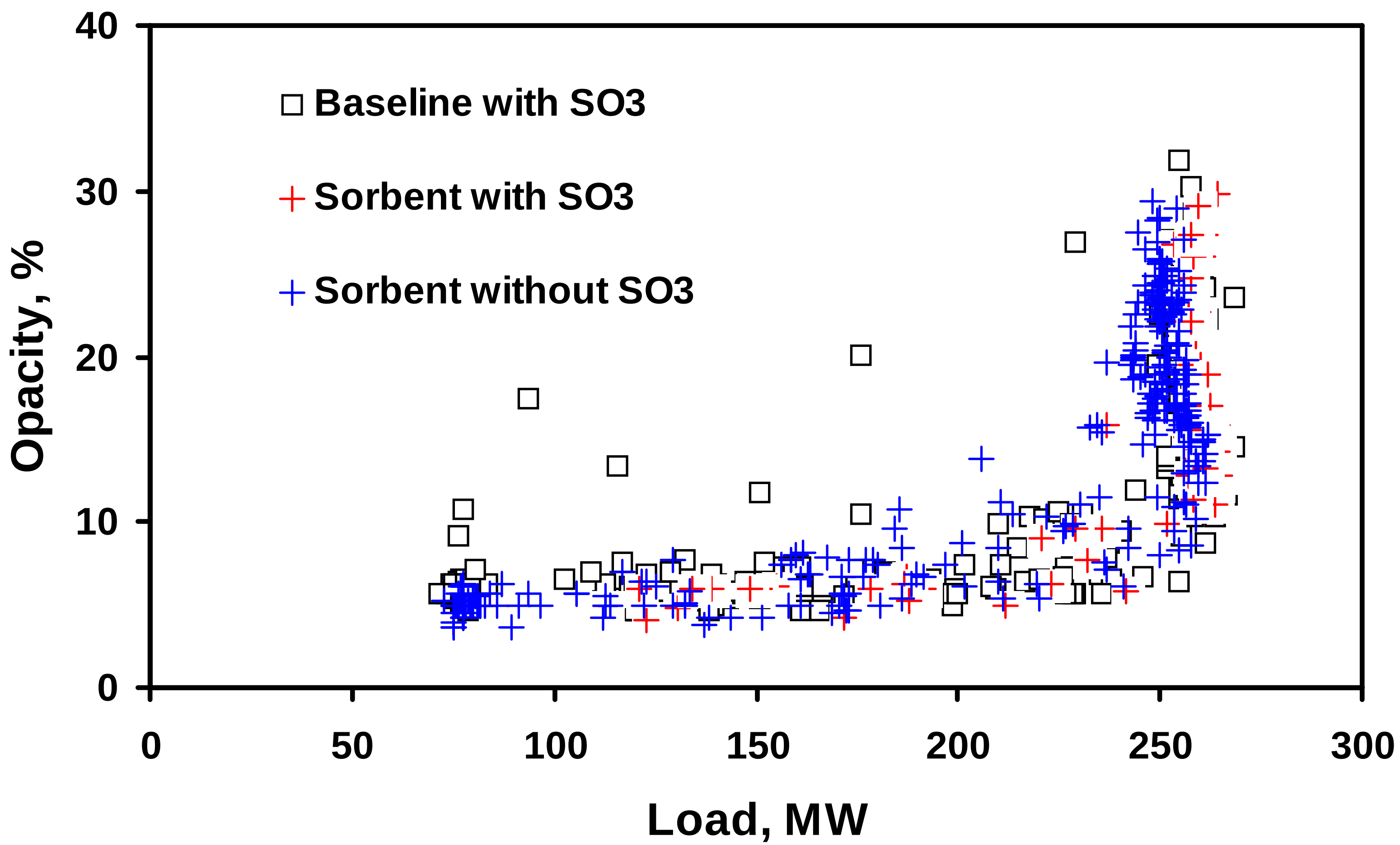
Darco Hg E25C injection

Experimental SO_3 resistant sorbent from Norit



No improvement in comparison with Darco Hg

Effect on opacity



No apparent effect of sorbent injection on opacity

Summary

- Combustion Optimization improved “native” mercury reduction and decreased NO_x emissions
- Not all optimized combustion conditions can be maintained in long-term operation
- Darco Hg and Darco Hg-LH showed similar performances
- SO_3 injection reduced sorbent reactivity by ~50%
- Darco Hg E25C did not show improved performance in SO_3 presence
- Mercury reduction target was difficult to meet in the presence of SO_3