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Long-Term Demonstration of Sorbent Enhancement Additive Technology for Mercury Control

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Presentation Outline

- Technology introduction
- Hawthorn Unit 5 (HAW5) (Kansas City Power & Light, KCP&L)
- Mill Creek Unit 4 (MC4) (Louisville Gas & Electric, LG&E)
- Conclusions
- Acknowledgments

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Sorbent Enhancement Additive (SEA) Technology

- SEA1 (B&W/Niro, U.S. Patent 5,435,980)
  - Chloride added to coal feed.
  - Hg capture can be enhanced with carbon.
- SEA2 T2
  - Added upstream of the particulate control device (PCD).
  - Carbon treated in situ.
  - Tailored to desired Hg removal.

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Sites

Plant	Utility Owner	Coal	Boiler Type	Boiler Size, MW	Partic. Control	SO_2 Control	NO_x Control
HAW5	KCP&L	PRB[1]	Wall-fired	550	FF[2]	SDA[3]	LNB[4], OFA[5], SCR[6]
MC4	LG&E	Eastern bituminous	Wall-fired	530	ESP[7]/ SCA[8]= 232	Wet FGD[9]	LNB, SCR

[1] Powder River Basin; [2] fabric filter; [3] spray dryer absorber; [4] low-NO_x burner; [5] overfire air; [6] selective catalytic reduction; [7] electrostatic precipitator; [8] specific collection area; and [9] flue gas desulfurization.

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Sampling Locations (both sites)

- Continuous mercury monitors (CMMs) – particulate collection device (PCD) inlet and stack for parametric tests. Stack only for long-term.
- Ontario Hydro (OH) – PCD inlet and stack for parametric tests and long-term.
- Solid samples – daily coal, ash, slurry samples during parametric. Three a week during long-term.
- U.S. Environmental Protection Agency (EPA) Method 5 – PCD inlet and stack?

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Hawthorn Unit 5

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Baseline Results

- Baseline Hg measurements indicate a native Hg capture average of 17.8 %*.
- Coal and OH inlet measurements are consistent
- CMM inlet and outlet measurements tend to be low for the baseline period when compared to OH and coal results, but agree well during Hg control technology testing.

Date	Test Description	Coal (Inlet) μg/Nm^3	CMM Inlet μg/Nm^3	OH Inlet μg/Nm^3	CMM Outlet μg/Nm^3	OH Outlet μg/Nm^3	Coal-to-Stack Hg Removal, %	
							OH	CMM
9/18/2006	Baseline	13.67	7.23	14.28	8.7	11.37	16.9	36.4
9/18/2006	Baseline	13.67	7.52	13.61	8.64	10.86	20.5	36.8
9/19/2006	Baseline	12.82	6.24	11.27	8.28	10.54	17.8	35.4
9/19/2006	Baseline	12.82	6.93	12.67	8.64	10.78	15.9	32.6

*Coal inlet to OH outlet basis.

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SEA1 Results

- Testing of SEA1 occurred during the period of 9/20/06–9/22/06.
- Results indicate a positive effect on Hg capture when compared to baseline removals.
- Hg removal efficiencies appear to only slightly increase with increasing SEA1 rate.

Date	Test Description	Coal (Inlet) μg/Nm^3	CMM Inlet μg/Nm^3	OH Inlet μg/Nm^3	CMM Outlet μg/Nm^3	OH Outlet μg/Nm^3	Coal-to-Stack Hg Removal, %	
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9/19/2006	Baseline	12.82	6.93	12.67	8.64	10.78	15.9	32.6
9/20/2006	SEA1 Only (600 ppm)	12.76	11.54	12.46	3.72	4.67	63.4	70.8
9/21/2006	SEA1 Only (800 ppm)	13.08	12.93	12.15	4.12	4.53	65.4	68.5

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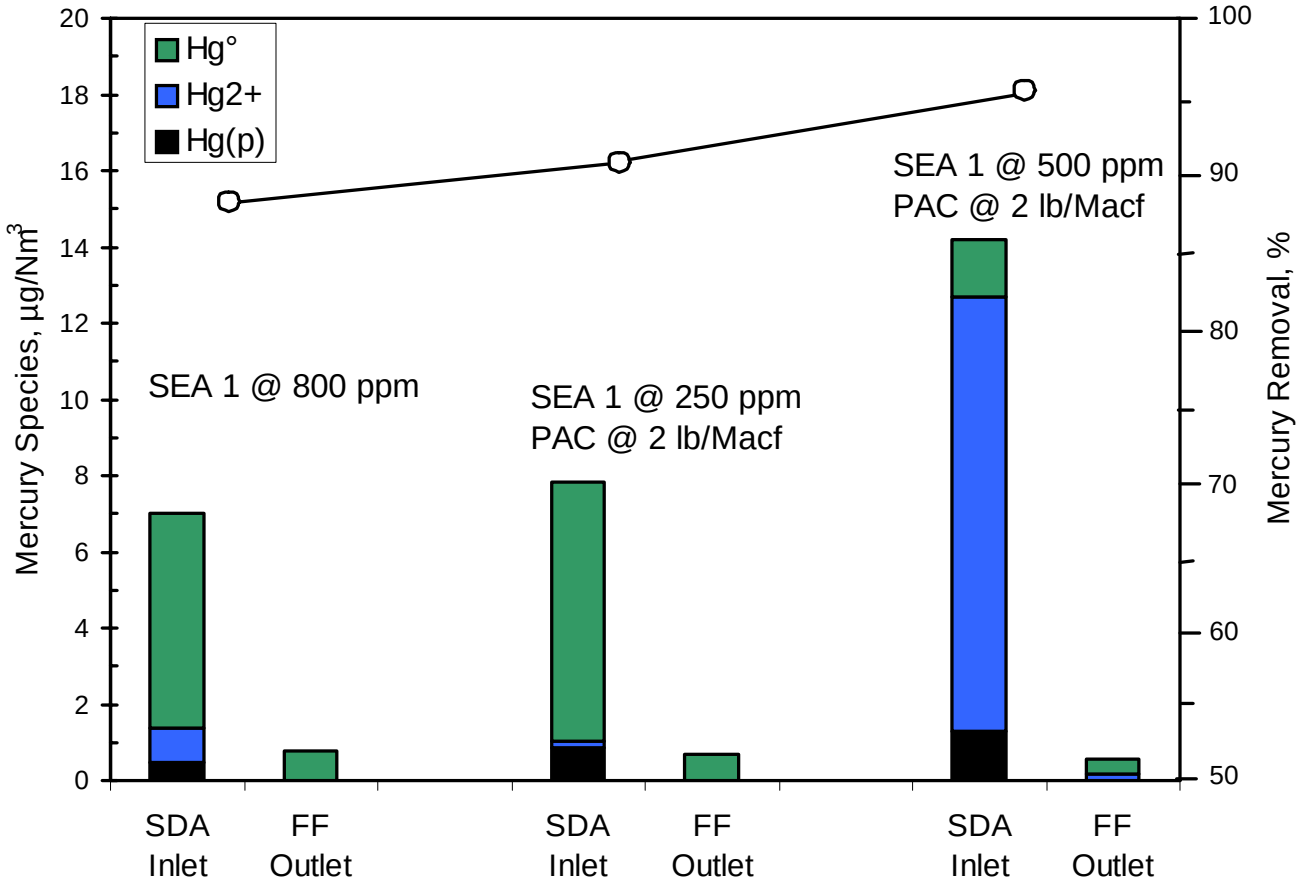
SEA 1 Results (cont.)



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Mill Creek Unit 4

- MC4 offers challenges with the selective catalytic reduction (SCR) system in service!
  - Possibly because of reactions with SO_3.

- SEA2 T2 and scrubber additives are the primary technologies tested at MC4.

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Previous MC4 Baseline

Sample Location	SCR Inlet, µg/Nm^3	SCR Outlet, µg/Nm^3	Wet FGD Inlet, µg/Nm^3	Stack, µg/Nm^3	Reduction, %
With the SCR in Service					
Hg^p	0.02	0.03	0.00	0.00	
Hg^0	8.32	2.83	0.33	3.97	
Hg^{2+}	0.94	5.05	7.60	0.54	
Hg_{total}	9.27	7.90	7.93	4.50	43.3
With the SCR Bypassed					
Hg^p			0.07	0.05	
Hg^0			2.44	2.63	
Hg^{2+}			6.79	0.55	
Hg_{total}			9.30	3.23	65.3

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Current MC4 Baseline

ESP Inlet (dry and 3% O_2), µg/m^3					Wet FGD Outlet (dry and 3% O_2), µg/m^3			
Sample	Hg(p)	Hg^{2+}	Hg^0	Hg (total)	Hg(p)	Hg^{2+}	Hg^0	Hg (total)
1	0.08	19.32	1.50	20.90	0.04	0.68	1.80	2.52
2	0.04	13.27	0.21	13.52	0.05	0.60	1.13	1.78
3	0.04	12.71	0.49	13.24	0.00	0.55	1.28	1.83
4	0.03	12.11	0.24	12.38	0.01	0.42	1.38	1.81

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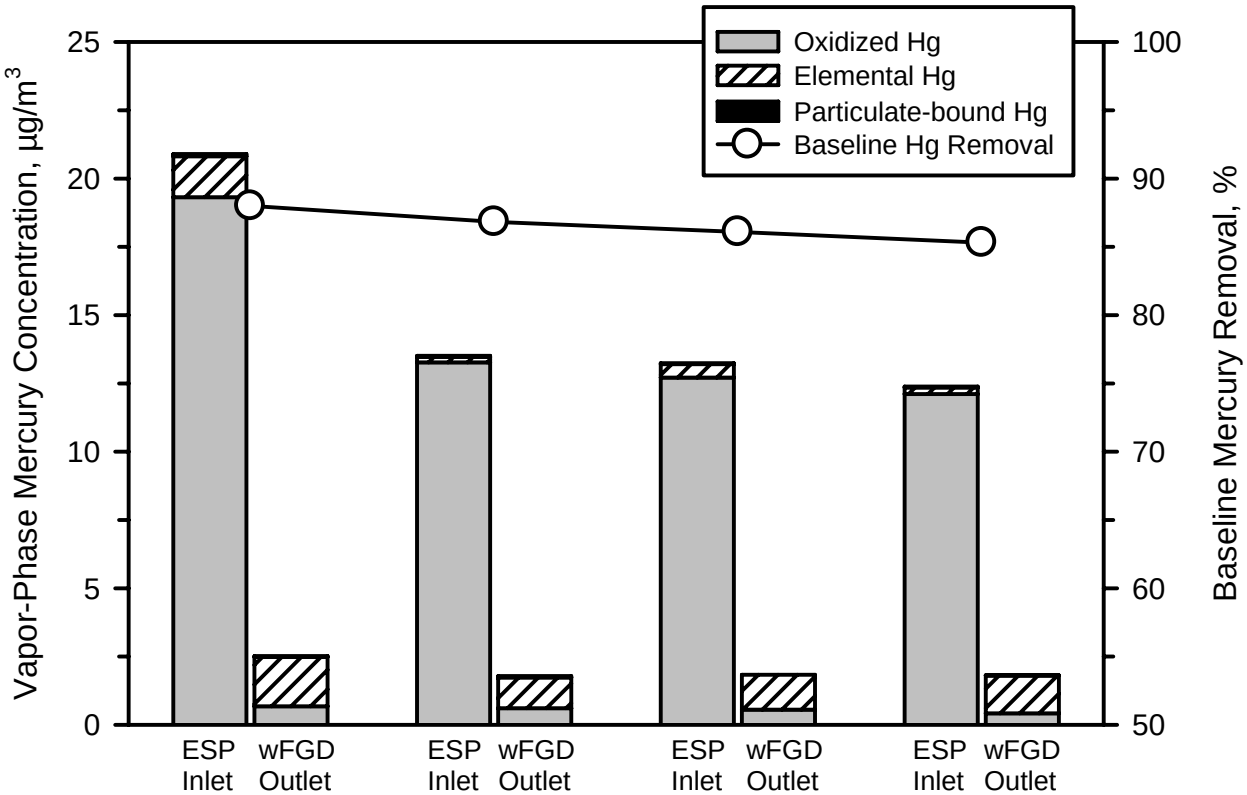
Baseline Removals



Baseline mercury removal was >80%.

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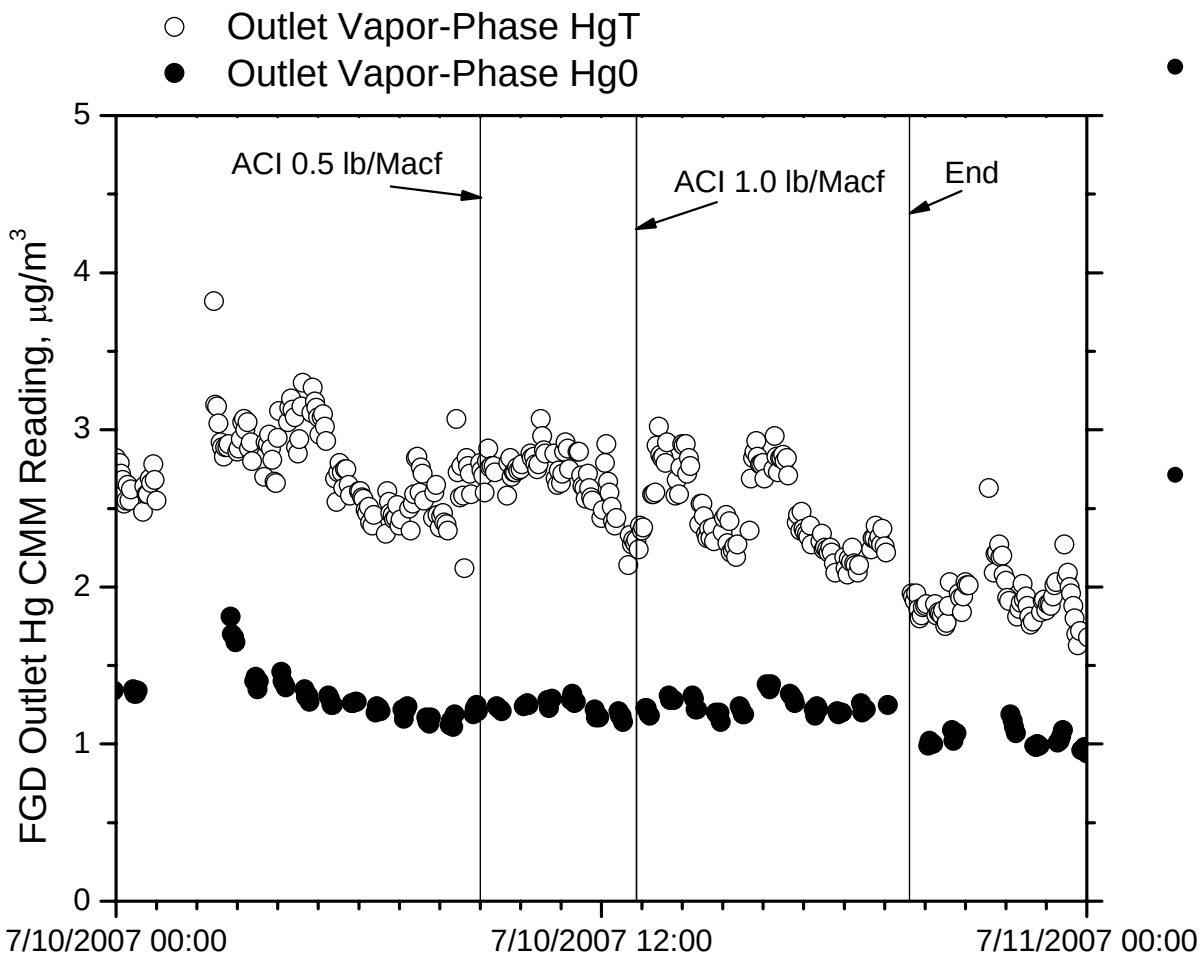
PAC Addition



- The addition of PAC at MC4 had no measurable effect on the mercury concentration.
- Possible interference with SO_3?

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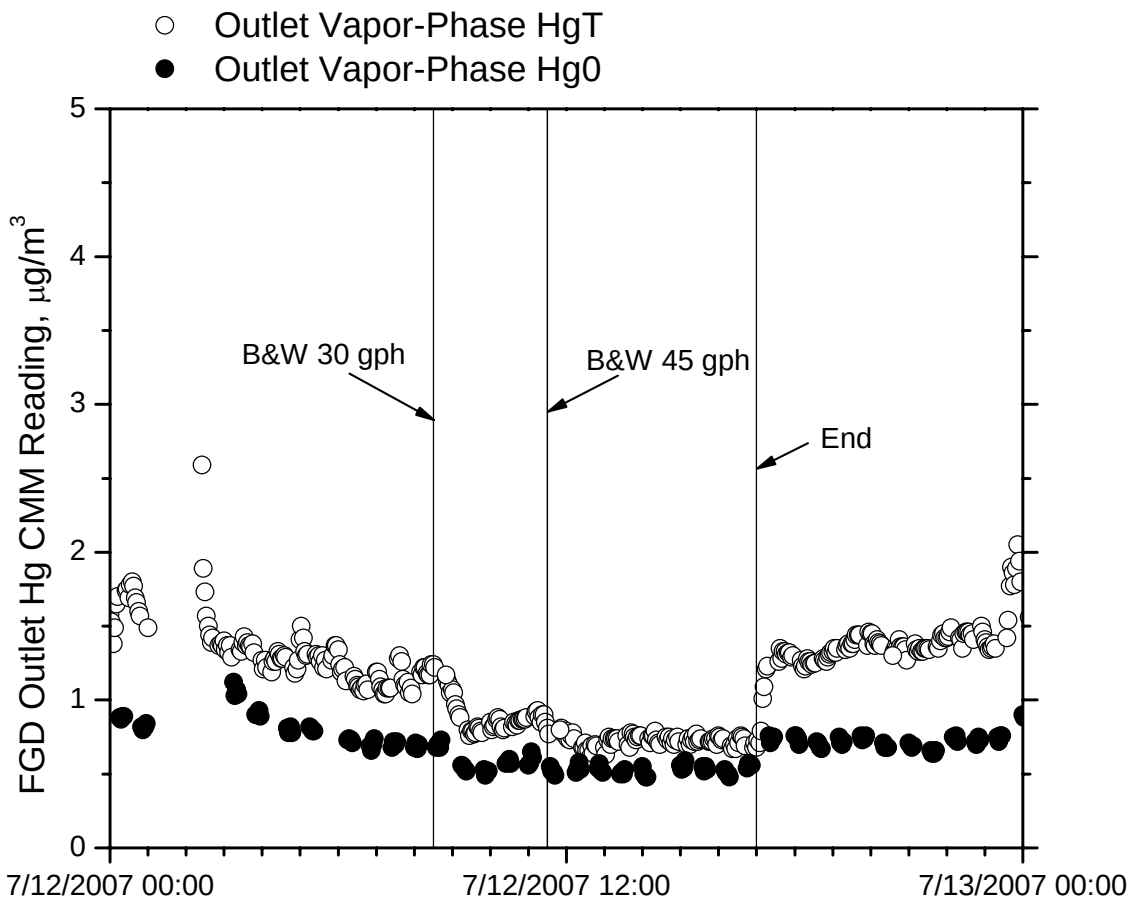
Scrubber Additives



The addition of B&W's scrubber additive into the wet FGD increased the amount of mercury retained in the scrubber solutions.

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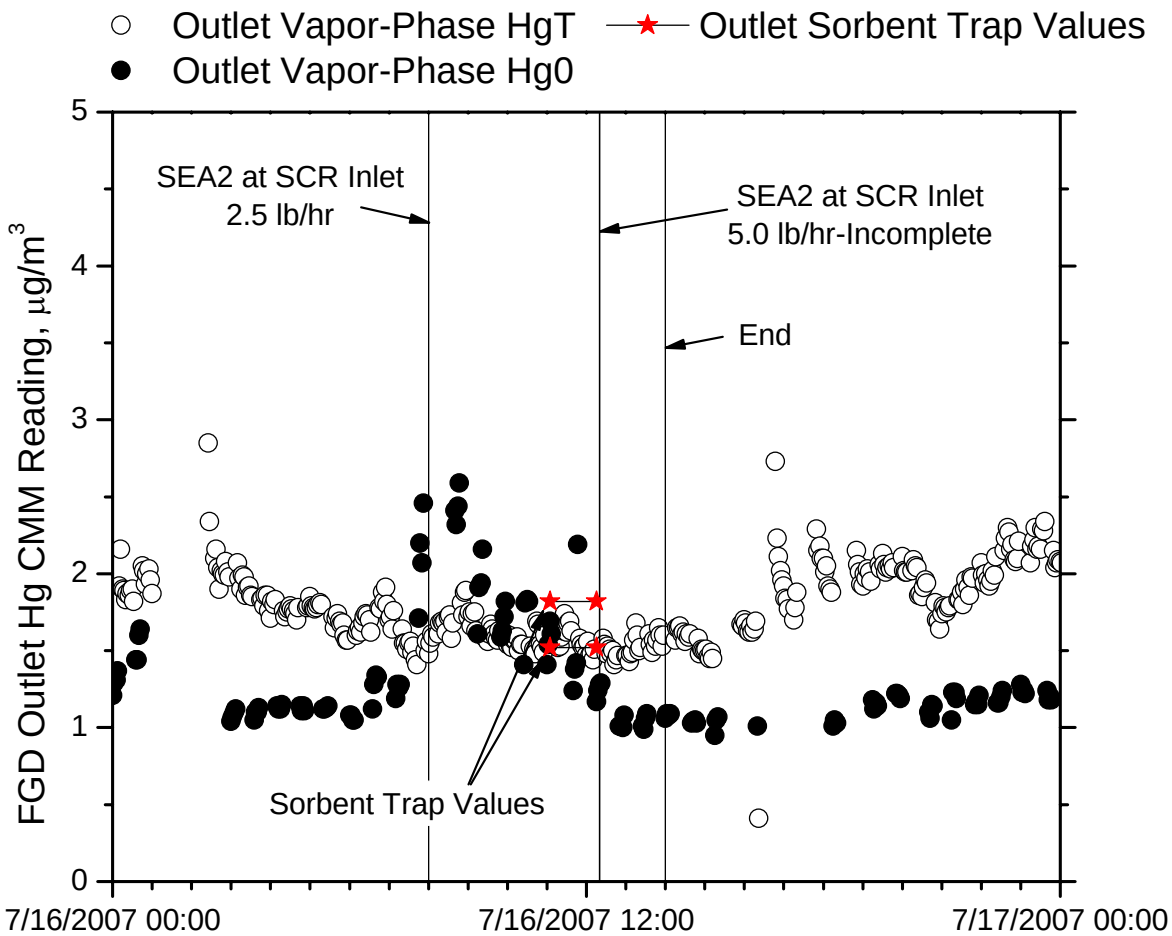
SEA2 T2



The SEA2 T2 technology did not significantly increase the amount of mercury captured.

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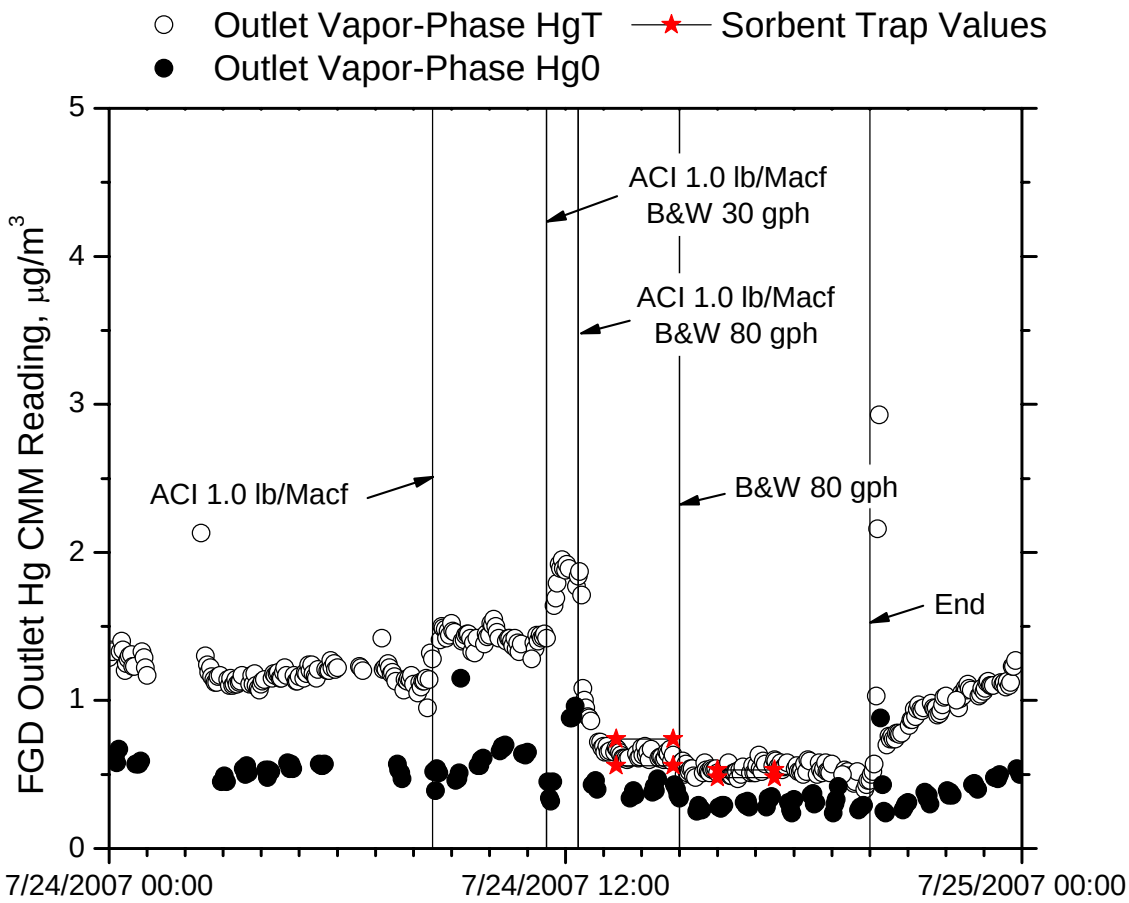
ACI and Scrubber Additives

The use of powdered activated carbon (PAC) with the scrubber additives had no beneficial removal.



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Sorbent Trap Results

Sample	Parametric Condition	Sorbent Trap Vapor-Phase Hg Dry at 3% O_2, μg/m³	Sorbent Trap Vapor-Phase Hg μg/m³	Average CMM Vapor-Phase Hg μg/m³
7A	SEA2 into SCR inlet at 2.5 lb/hr	2.33	1.52	1.56
7B		2.78	1.82	
Average		2.55	1.67	
8A	ACI (1.0 lb/Macf) and SEA2 (5.0 lb/hr) into ESP inlet[a]	2.65	1.68	1.76
8B		3.42	2.17	
Average		3.03	1.92	
9A	ACI (1.0 lb/Macf) and SEA2 (2.5 lb/hr) into ESP inlet[b]	2.55	1.64	1.70
9B		3.36	2.17	
Average		2.95	1.90	
1A	ACI (1.0 lb/Macf) into ESP inlet and B&W additive at 80 gph	0.87	0.56	0.63
1B		1.15	0.74	
Average		1.01	0.65	
2A	B&W additive at 80 gph	0.74	0.48	0.54
2B		0.82	0.53	
Average		0.78	0.50	

[a] SEA2 stopped after approximately 30 minutes of sampling.
[b] SEA2 stopped after approximately 20 minutes of sampling.

Long-Term Study at MC4

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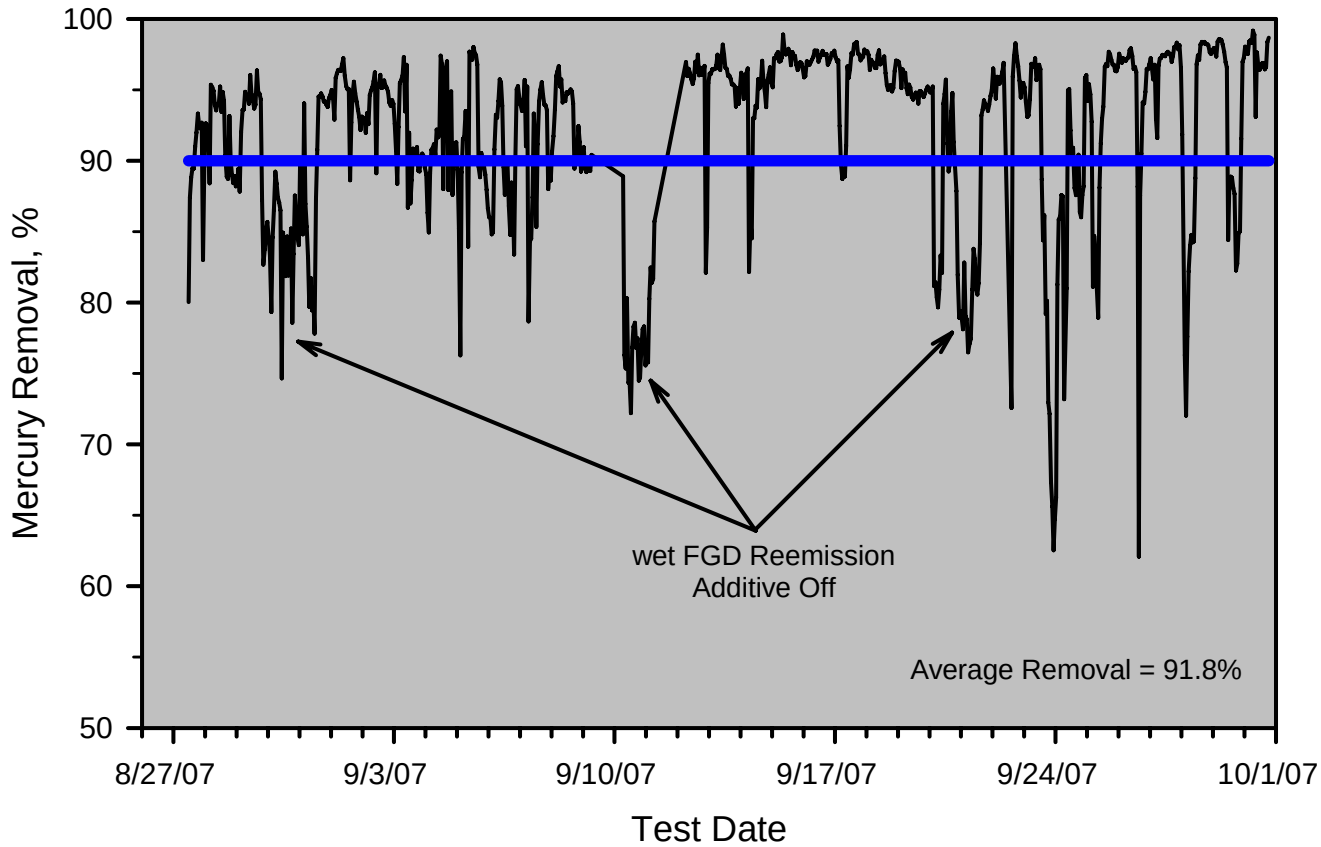
Mercury Removal Using B&W Wet FGD Reemission Additive



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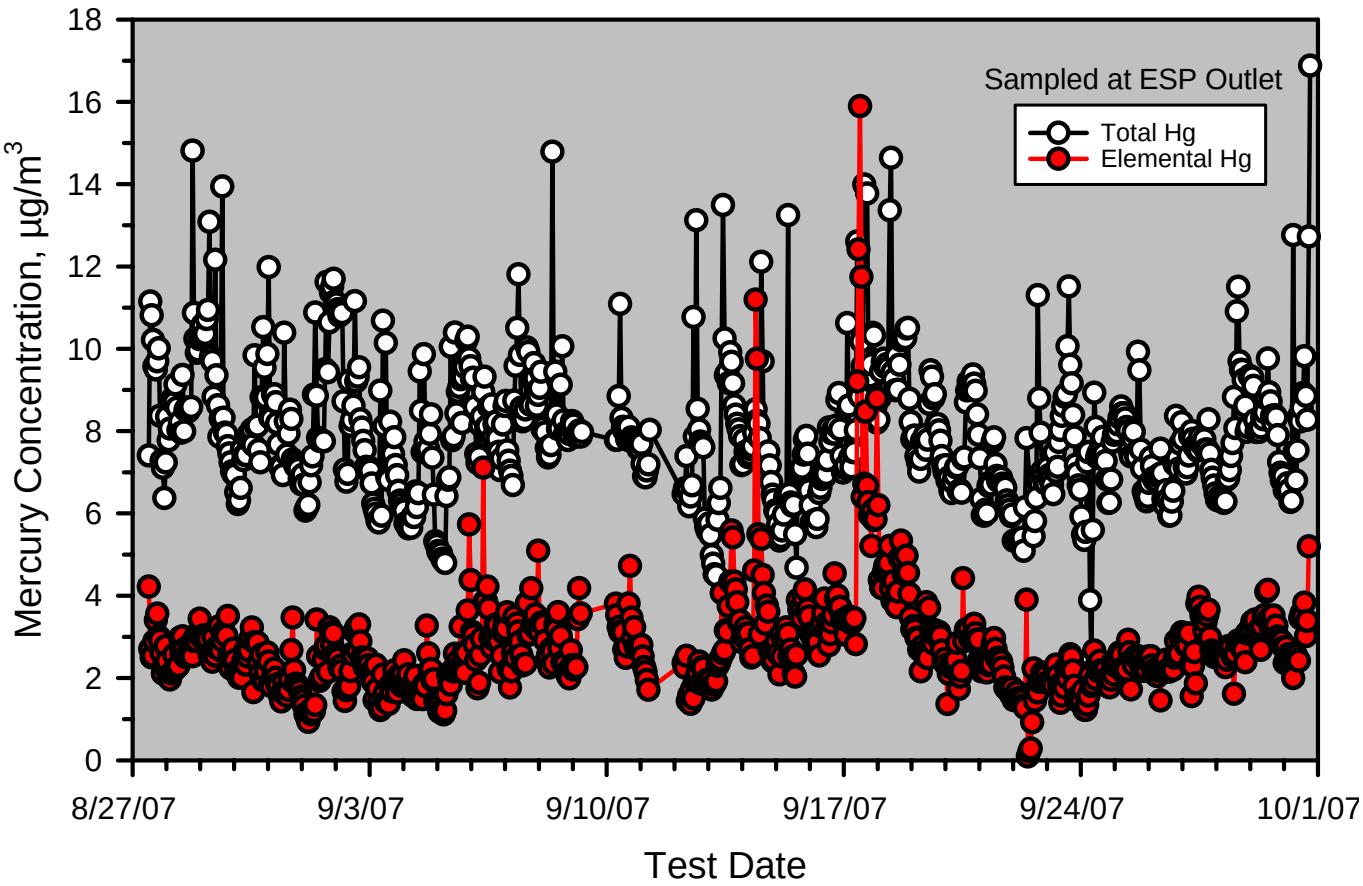
Mercury Concentration at the Electrostatic Precipitator Outlet at MC4



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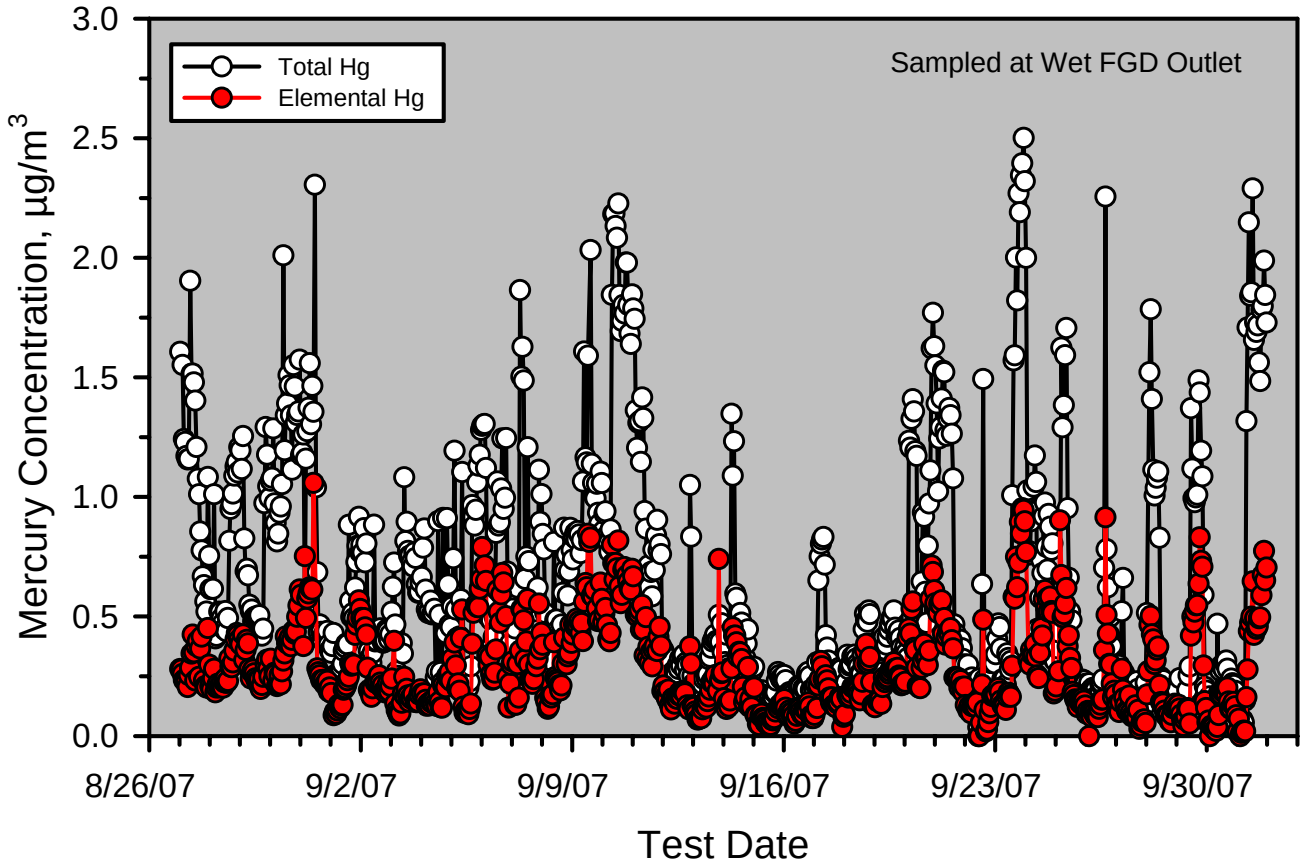
Hg Concentration at Wet FGD Outlet Using B&W Reemission Additive



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Conclusions

- The amount of reemission observed at MC4 is significantly lower than previously reported.
- The addition of PAC at MC4 had no measurable effect on the mercury concentration.
- The use of the B&W scrubber additive allowed for mercury concentrations below 0.6 mg/m^3 at the scrubber outlet.
- Reasonable agreement between CMM and sorbent trap values.
- >90% mercury reduction was possible at the HAW5 with SEA1 (500 ppm) and PAC (2 lb/macf).
- Catalyst blinding observed at HAW5 led to lower oxidized Hg levels.

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