

Wet FGD Additive for Enhanced Mercury Control



Luminant



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Project Overview

- Co-funded by DOE-NETL, EPRI, Luminant Power, Southern Company, AES, Degussa Corporation, and Nalco
 - DE-FC26-04NT42309 “Field Testing of a Wet FGD Additive for Enhanced Mercury Control”

Project Objective

- Prevent or minimize Hg⁰ “re-emissions” from wet FGD systems
- Field tests (pilot to full scale) of additives for optimizing Hg capture by wet FGD
 - Use of additives rather than altering FGD chemistry to limit or eliminate re-emissions
 - Lower Hg in gypsum byproduct
 - Enhance stability of Hg in gypsum used for wallboard?

Additive Selection

- At beginning of this DOE co-funded project (2004), only two FGD re-emission additives were identified: B&W's NaHS and DeGussa's TMT-15
- B&W additive was evaluated in previous DOE-NETL project, so this project focused on TMT-15
- Later in the project, Nalco's 8034 was added to the test program

Additive Tests

- Additives tested: Degussa TMT-15 and Nalco 8034
 - Form insoluble salts with Hg^{2+}
- Effectiveness of additives determined by :
 - Reduced Hg concentrations in the FGD liquor
 - Gas phase Hg measurements of re-emissions (absorber inlet & outlet)

Pilot Testing Completed in 2005 (previously reported)

- Luminant Monticello Unit 3 (two weeks)
 - Texas Lignite/PRB, limestone/forced oxidation FGD
- Southern Co. Plant Yates Unit 1 (one week screening TMT dosage effects in JBR)
 - Low S Eastern Bituminous, limestone/forced oxidation FGD
- Both pilot tests showed TMT effective at precipitating Hg from FGD liquor
- Neither clearly demonstrated control of re-emissions due pilot outlet gas phase Hg measurement issues



Full-scale Testing Completed in 2006 (previously reported)

- IPL Petersburg Unit 2 (2 weeks of testing)
 - Medium S, Eastern Bituminous, Limestone/forced oxidation
- Results showed little, if any, effect of TMT
 - Re-emissions were lower, maybe within normal variation
 - Absorber liquor Hg concentrations did not decrease



2007 Full-scale Testing

- TMT-15 test at Plant Yates Unit 1 (May)
 - 15-day test

- Nalco 8034 test at Plant Yates Unit 1 (August-September)
 - 30-day test

Plant Yates Unit 1 Testing Approach

- Baseline evaluation of Hg removal across wet FGD
 - Gas phase Hg measurements (Absorber Inlet & Outlet)
 - Ontario Hydro, plant CEM, & URS SCEMs
 - Hg partitioning between FGD liquor and solid byproducts
- Initial screening of additive dosage rate
- Steady-state addition test at “optimum” dosage
 - same measurements as during baseline evaluation

Plant Yates Full-scale TMT-15 Test Results (May 2007)

- As at IPL Petersburg, test on Plant Yates JBR showed little effect of TMT
 - ~50% reduction in FGD liquor Hg concentration
 - Surprising considering effectiveness seen in pilot JBR in 2005
 - No decrease in re-emissions compared to baseline
 - Stopped test after 15 days due to apparent lack of effect on Hg in liquor or re-emissions



Effect of TMT Addition on JBR Liquor Hg

TMT Addition Rate (mL/ton of coal)	Full-scale JBR Liquor Hg ($\mu\text{g/L}$)	Pilot-scale JBR Liquor Hg ($\mu\text{g/L}$)
0 (baseline)	196 (5/15/07)	7.52 (8/18/05)
20	156 (5/18/07)	<0.25 (8/21/05)
40	139 (5/24/07)	-
40	111 (5/25/07)	-
40	103 (5/30/07)	-

FGD Byproduct Hg Data for Full-scale JBR TMT-15 Additive Test

	Full-scale		Pilot-scale	
	Baseline	w/TMT-15	Baseline	w/TMT-15
TMT Dosage (mL/ton of coal)	0	40	0	20
Hg in FGD Liquor, $\mu\text{g/L}$	196	103	7.5	<0.25
Hg in FGD Blow Down Slurry Solids, $\mu\text{g/g}$	0.29	0.19	0.29	0.15
% of Hg in Liquor Phase (vs.solids) of FGD Blow Down Slurry	40	35	70	<1.6

Yates Full-scale JBR Re-emissions, by OH Method

	JBR Inlet Hg $\mu\text{g}/\text{Nm}^3 @ 3\% \text{O}_2$ [lb/10 ¹² Btu]	Stack Hg $\mu\text{g}/\text{Nm}^3 @ 3\% \text{O}_2$ [lb/10 ¹² Btu]	% Hg Removal	Hg Re-emission (% of inlet Hg ⁺²)
Baseline (5/15/07):				
Hg ⁺²	3.4	0.2	95	-
Hg ⁰	3.6	4.6	-27	29
Total Hg	7.0 [4.6]	4.8 [3.2]	31	-
TMT @ 40 mL/ton of coal (5/24/07):				
Hg ⁺²	4.8	0.5	89	-
Hg ⁰	4.7	7.5	-59	58
Total Hg	9.5 [6.3]	8.0 [5.3]	16	-

Full-scale Nalco 8034 Test (August-September 2007)

- Conducted second test at Plant Yates, using Nalco 8034 additive
 - Shown effective at bench-scale and in privately funded pilot-scale test (PRB coal)
- Baseline re-emissions changed and were very low (much lower than were seen in May test)
 - Lower re-emissions thought to be due to low Hg concentrations in FGD liquor



Big Difference in Baseline JBR Liquor Hg Concentrations

Date	JBR Liquor Hg ($\mu\text{g/L}$)
5/15/07 (no additive)	196
8/28/07 (no additive)	0.34

- Difference speculated to be due to change in limestone supply for JBR
 - Ball mill down in May, used dry-ground limestone from a 3rd party
 - Ball mill back in service in August, used normal limestone source
 - Possible iron/other metal effect from stone or grinding media?

Effect of Nalco 8034 Addition on JBR Liquor Hg

Date	JBR Liquor Hg ($\mu\text{g/L}$)
8/28 (baseline)	0.34
8/30	0.26
8/31	0.20
9/7	0.16
9/8	<0.16
9/17	0.84
9/18	0.76
9/27	1.55

Increase towards end of test may be due to changes in JBR operation

FGD Byproduct Hg Data for Full-scale JBR Nalco Additive Test

	Baseline (No Additive) 8/28/07	w/Nalco Additive 9/18/07
Hg in FGD Liquor, $\mu\text{g/L}$	0.34	0.76
Hg in FGD Blow Down Slurry Solids, $\mu\text{g/g}$	0.28	0.44
% of Hg in Liquor Phase (vs.solids) of FGD Blow Down Slurry	0.6	0.8

Yates Full-scale JBR Re-emissions, by OH Method

	JBR Inlet Hg ($\mu\text{g}/\text{Nm}^3$ @3 % O ₂) [lb/10 ¹² Btu]	Stack Hg ($\mu\text{g}/\text{Nm}^3$ @3 % O ₂) [lb/10 ¹² Btu]	% Hg Re- moval	Hg Re- emission (% of inlet Hg ⁺²)
Baseline (8/28):				
Hg ⁺²	2.9	<0.3	>90	-
Hg ⁰	3.7	4.2	-14	18
Total Hg	6.6 [4.4]	4.2 [2.8]	36	-
w/Nalco addition (9/18):				
Hg ⁺²	3.4	<0.5	>87	-
Hg ⁰	4.5	4.7	-5	7
Total Hg	7.9 [5.4]	4.7 [3.2]	41	-

Minor
Reduction in
re-emissions

Ongoing Project Efforts

- Completing in-house FGD sample analyses
- FGD liquor/solid sample aliquots from May and August are being analyzed for metals analyses
 - investigate possible correlation with change in liquor Hg concentrations
- Final report due in March 2008

Summary

- Pilot-scale TMT-15 test results:
 - Inconclusive about effectiveness of TMT in controlling Hg⁰ re-emissions
 - Show expected effects of TMT in FGD byproducts
 - Greatly reduced Hg in FGD liquor
 - Most of the Hg reports to fines in FGD solids
- Full-scale TMT-15 test results:
 - Modest decrease in re-emissions across absorber at Petersburg, increase in re-emissions at Plant Yates
 - Do not show expected effects of TMT addition in absorber liquor
 - No reduction in Hg in FGD liquor at Petersburg
 - 50% reduction in Hg in FGD liquor at Plant Yates

Summary (continued)

- Full-scale Nalco additive test results:
 - Test confounded by low baseline FGD liquor Hg concentrations, low baseline re-emission levels
- More work is needed to determine why additives work at some sites, not at others
- Need better understanding of how much re-emissions & Hg partitioning vary without additives, and why