Hg Emission Control Technologies Investigation

September 10, 2015 MPCA Meeting

J. Skelley, K. O'Halloren - Gerdau

Gerdau St. Paul Hg Emission Control Plan submitted to MPCA – June 2015

#	Activity/Milestone	Date		Notes
1	Initiate Review of Alternative Hg Control Technologies	5/1/15	*	If additional review is required.
2	Hg Emission Reduction Plan Due to MPCA	6/30/15	*	Plan must be delivered on or before
3	Complete Review of Alternative Hg Control Technologies	8/31/15	*	
4	Obtain Quote for Installed Cost of BPAC System	10/1/15	*	
5	Conduct Testing of Calcium Polysulfide Technology	10/31/15	*	Test window August - October.
6	Obtain Quote for Calcium Polysulfide Technology if Effective	11/30/15	*	
7	Decision on Final Technology Selection	12/15/15	*	
8	Incorporated Equipment in CAP-X Plan	12/31/15	*	
9	Update Hg Emission Reduction Plan	1/31/16	*	Update in needed to finalize technology selection
10	Begin Engineering	2/1/16	*	
11	Complete 1150(C) Notification or Permit Modification Request	3/31/16	*	May only require notification (need to verify)
12	Begin Equipment Purchase	5/31/16		4 months after initiation of engineering
13	Complete Engineering	7/30/16		6 months for engineering
14	Obtain Air Permit Modification for Construction	8/28/16		Allow 5 months for permit modification
15	Complete Equipment Purchase	2/25/17		9 months total
16	Install New Hg Control Equipment	3/1/17	*	Begin installation of equipment
17	Complete Hg Control Equipment Installation	6/1/17	*	3 months for installation
18	Submit Compliance Test Protocol to State	9/18/17		6 months before compliance test
19	Conduct Compliance Test	3/17/18		45 days prior to final report
20	Compliance Test Report to MPCA	5/1/18		2 months before compliance deadline
21	Compliance Deadline	6/30/18	*	

Regulatory (shaded rows)

GERDAU

Current Hg control technologies in APC systems

- Activated Carbon (halogenated and non-halogenated)
  - Filtration
    - bags with carbon coating or carbon incorporated into bag structure,
    - carbon filters,
    - carbon columns
  - Injection in fume system, then PM removal by baghouses, electrostatic precipitators
    - BPAC system used at Sayreville
- Various sorbents, with chemical scavenging agents
  - Sorbents include flyash, limestone, lime, hydrated lime, calcium sulfate, calcium sulfite, activated carbon, charcoal, silicate, alumina, and various mixtures.
  - Scavenging agents include bromine, bromochloride, sulfur bromide, sulfur dichloride or sulfur monochloride, and various mixtures
  - APC (air pollution control) equipment
    - Scrubber systems
      - Wet scrubbers (slurry injection)
      - Dry scrubbers (powder injection)
    - Injection in fume systems, then PM removal by baghouses, electrostatic precipitators

Background – St. Paul Study

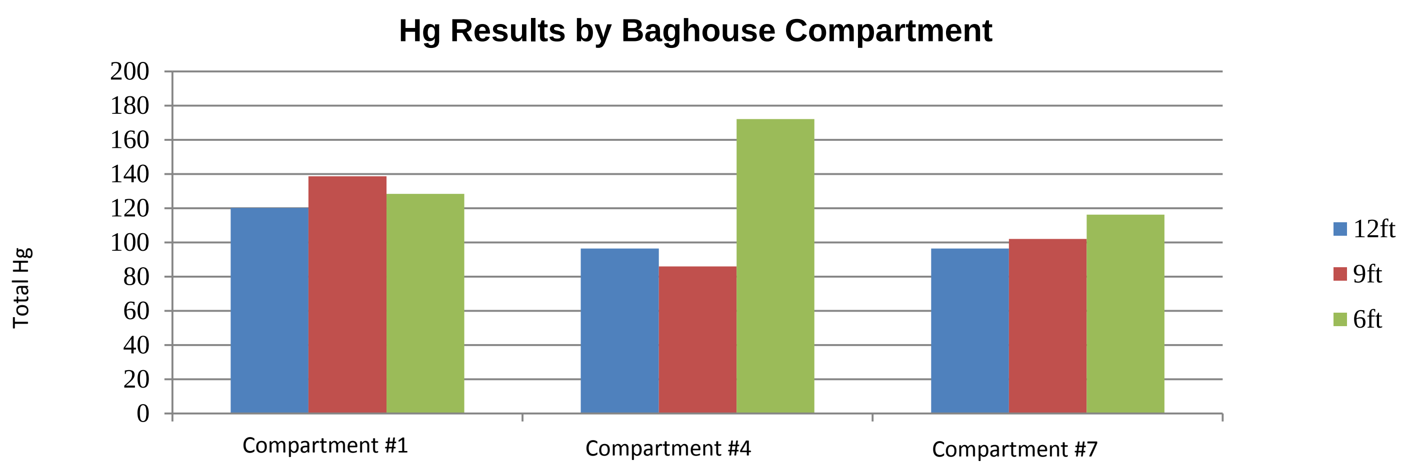
- Pre-Test – April 2013
  - Installed Hg CEMS at the baghouse inlet to gain an understanding of any process variability in Hg emissions
  - Stratification and speciation testing
  - Flow measurements for each baghouse compartment

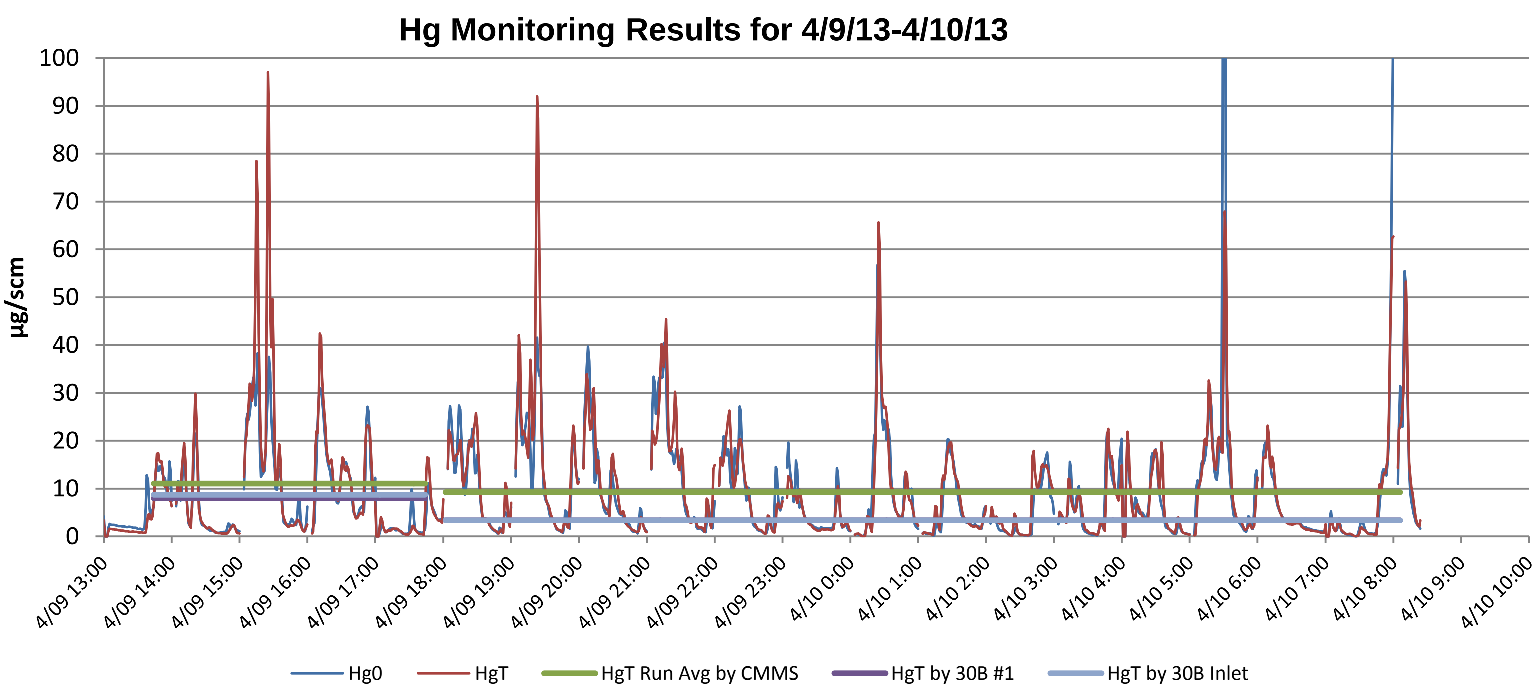
- Pre-Test Conclusions
  - Hg is highly variable in the flue gas
  - Virtually no native Hg removal from the baghouse
  - Baghouse Compartment 1 appeared to be the most conservative compartment for Hg testing during the field trial

EAF Baghouse Inlet and Outlet Method 30B Results

Run Number	Run Duration	EAF Baghouse Inlet Hg(T)		EAF Baghouse Outlet – Compartment #1 Hg(T)	
		ug/dscm	mg/ton	ug/dscm	mg/ton
Run 1	4 hours	8.69	112.771	7.96	103.298
Run 2	14 hours	3.35	33.426	3.34	33.426

Background – St. Paul Study





Background – St. Paul Study

Field Study Results

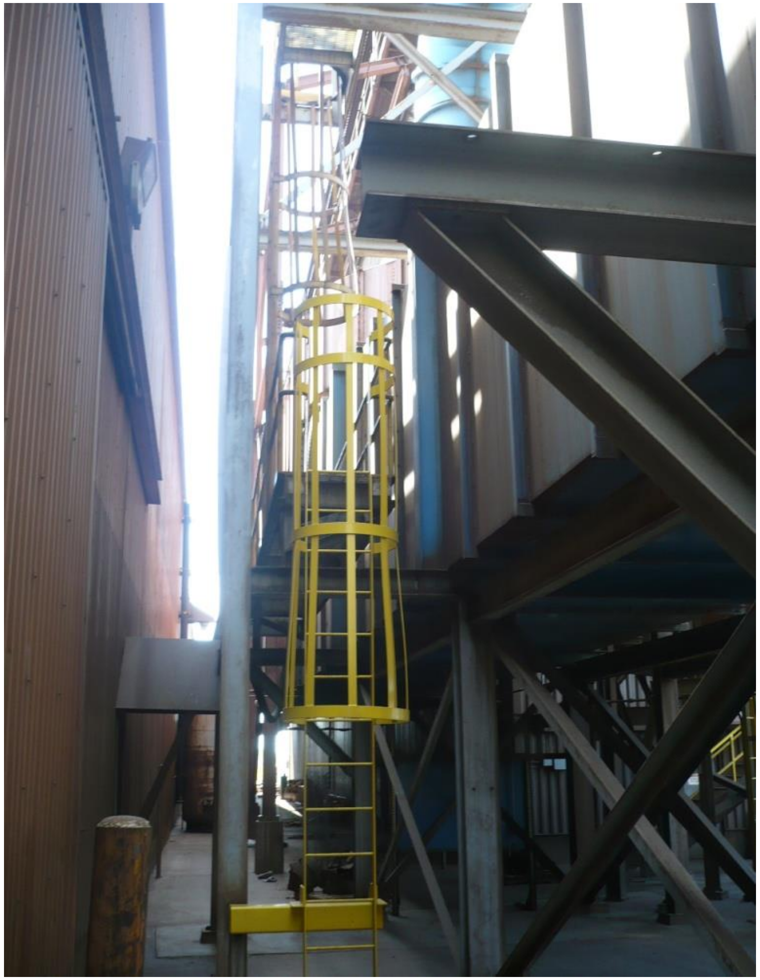
- Field Study Conducted in June 2013
  - Evaluated brominated powdered activated carbon (BPAC) and amended silicates as the Hg control technologies
  - Both technologies resulted in high Hg oxidations
  - Mixed results with amended silicates
  - BPAC proven to be successful, as expected from Sayerville

Sorbent Material	Date	1st Charge Start	Tap	Condition	Melt Yield	Stack Flow Rate	Charge to Tap	ASI Injection Rate	ASI Dose	Inlet Hg (0)	Inlet Total Hg	Stack Hg (0)	Stack Total Hg	Hg Oxidization	Hg(T) Mass Rate, Inlet	Hg(T) Mass Rate, Outlet	Overall System Hg Removal
	2013	HH:MM	HH:MM		ton	dscfm	min	lb/hr	lb/MMacf	µg/dscm	µg/dscm	µg/dscm	µg/dscm	%	mg/Ton	mg/Ton	%
Br-PAC	24-Jun	14:26:00	17:48:00	2 Heats	169.2	459,762	208.18	25	0.9	6.96	8.93	0.49	0.95	93.0%	143.03	15.21	89.4%
Br-PAC	25-Jun	10:06:00	14:06:00	3 Heats	244.3	459,762	145.37	25	0.9	3.36	4.70	0.34	0.85	90.0%	36.44	6.55	82.0%
		14:38:00	18:03:00	3 Heats	255.3	459,762	136.27	25	0.9	3.60	5.45	0.23	0.63	93.7%	37.86	4.41	88.4%
Br-PAC	26-Jun	11:13:00	14:03:00	2 Heats	174.0	459,762	190.70	50	1.8	6.90	9.01	0.33	0.64	95.2%	128.56	9.13	92.9%
		16:37:00	18:36:00	2 Heats	180.2	459,762	128.83	25	0.9	12.17	18.75	0.98	2.02	91.9%	174.52	18.80	89.2%

Sorbent Material	Date	1st Charge Start	Tap	Condition	Melt Yield	Stack Flow Rate	Charge to Tap	ASI Injection Rate	ASI Dose	Inlet Hg (0)	Inlet Total Hg	Stack Hg (0)	Stack Total Hg	Hg Oxidizatio n	Hg(T) Mass Rate, Inlet	Hg(T) Mass Rate, Outlet	Overall System Hg Removal
	2013	HH:MM	HH:MM		ton	dscfm	min	lb/hr	lb/MMacf	µg/dscm	µg/dscm	µg/dscm	µg/dscm	%	mg/Ton	mg/Ton	%
Amended Silicates	17-Jun	12:10:00	14:47:00	3 Heats	261.5	459,762	157.00	100	3.6	9.91	10.96	0.18	2.61	98.2%	85.70	20.41	76.2%
		15:52:00	18:42:00	3 Heats	258.6	459,762	170.00	100	3.6	7.79	11.03	0.87	7.02	88.9%	94.42	60.10	36.3%
Amended Silicates	18-Jun	12:29:59	15:21:21	2 Heats	180.2	459,762	171.37	196	7.1	19.36	22.02	0.75	6.35	96.2%	272.69	78.58	71.2%
		16:14:27	18:13:31	2 Heats	174.8	459,762	119.07	183	6.6	9.87	11.92	0.73	4.69	92.6%	105.67	41.59	60.6%
Amended Silicates (Milled)	19-Jun	9:38:06	12:07:23	3 Heats	263.4	459,762	149.28	81	2.9	8.11	11.40	1.88	10.89	76.8%	84.13	80.35	4.5%
		13:19:53	14:52:25	2 Heats	168.3	459,762	92.53	56	2.0	21.64	28.46	0.70	5.70	96.8%	203.73	40.83	80.0%
		14:58:37	17:48:48	3 Heats	257.2	459,762	170.18	155	5.6	3.88	7.26	0.69	8.10	82.2%	62.54	69.77	-11.6%

Field Study Results

- Field Study Conclusions/Lessons Learned – Amended Silicates
  - During AS testing inlet total Hg averaged 129.8 mg/Ton
  - AS had inconsistent control results
  - Milled AS was not effective
  - Low air-to-cloth ratio (~2 fpm) results in low air velocity in baghouse
  - Filter bags are ~32 ft in length
  - Combination of low velocity and long bags makes it difficult for higher density AS particles to effectively coat the entire length of the bags



Field Study Results

- Field Study Conclusions/Lessons Learned – BPAC

  - During BPAC testing inlet total Hg averaged 79.6 mg/Ton (lower than AS runs)
  - BPAC was successful
  - Residence time was not a significant factor for Hg removal
  - Based on short term field study, injection rates of 25 lb/hr or less should meet proposed MPCA Hg regulations

Developing Hg control technologies

- Aqueous calcium polysulfide polymer solution injection
  - Injection in fume system, fixate heavy metals in emission control dusts for removal by fabric filter baghouses for particulate control
    - An aqueous, non-combustible, composition for removing heavy metal fume in gas and particulate streams using a sulfide polymer solution injection.
    - Most currently employed sorbent-fixant solutions are slurries, not aqueous liquids.
      - Liquid solutions offer better injection control and less maintenance issues with tank and spray delivery systems
- Custom Environmental Inc.
  - October 2010
    - Initial laboratory bench testing done with EAF dust samples from WIL showed Hg control levels of 90% between treated and untreated emission streams
  - July 2011
    - Construction of a baghouse simulator is near completion for efficacy testing on actual Hg vapor streams across a polyester bag.
    - Original testing was done on heated and blown EAF dust fume.
    - Next testing phase is to address questions concerning dynamics of the Hg vapor phase in baghouses.
  - Aug.-Sept. 2011
    - Hg vapor phase testing in baghouse simulator was conducted. Results showed 75-90% control of Hg vapor phase emissions.

Custom Environmental, Inc. - baghouse simulator for Hg vapor emission control trials

Heater

Mercury volatilization chamber

Flow splitter chamber

Treatment duct

Control (no treatment) duct

Treatment Duct Baghouse*

Control Duct Baghouse*

* Baghouses have polyester bag (supplied by WIL) for testing purposes

Scrubber (final Hg treatment for emission discharge) **and negative pressure blower**

- Flows in simulator mimic retention times in actual EAF baghouses
- Simulator designed to allow testing of Hg vapor phase and treatment efficiency across bag fabric.

Next Step – Calcium Polysulfide Polymer Trial at St. Paul EAF Baghouse.

- The trials are scheduled for the week of Sept. 21-25, 2015

GERDAU