Mercury Emissions Control in a Cupola - Case Study

Atlantic States Cast Iron Pipe Co.

Phillipsburg, NJ

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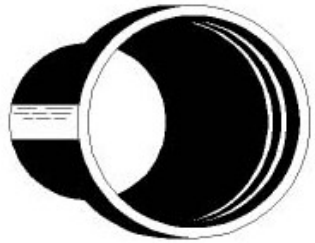
Atlantic States



- Phillipsburg, NJ
- Employs approx. 300 people
- Cupola melts up to 75 tons per hour
- 750 tons per day
- Seven Delavaud centrifugal casters
- 6” to 24” inch diameter ductile iron pipe
- Other processes include annealing, finishing, cement lining, painting

What is the Problem with Hg?

- Hg is a bio-cumulative and persistent toxic pollutant that can be released into the air, soil, and water.
- Atmospheric transport and deposition creates a wide range of emission impacts
- It has been estimated that 10 tons per year of Hg is released to the environment from scrap processing of end-of-life vehicles in NJ.

Mercury Regulations in New Jersey

- On April 13, 2007, a NJ Appeals Court upheld the Hg emission limits imposed by the NJDEP on Iron & Steel Melters relative to health-based justification.
- By January 3, 2010, foundries must achieve an Hg emission rate of 35 mg/ton of iron or steel produced or 75% control efficiency, either by purchasing mercury free scrap, installing add-on controls, or a combination of both.

Mandatory New Jersey Source Reduction Program

- On March 23, 2005, NJ legislature enacted a mandatory collection and recovery program for Hg switches from end-of-life vehicles.
- Historically, automobiles used Hg switches for convenience lighting and ABS.
- Vehicle recyclers and scrap recyclers that accept end-of-life vehicles are required to remove and properly handle the Hg switches.
- Vehicle manufacturers are required to provide containers, pay for transportation, pay a min. $2.00/switch to recyclers and $0.25/switch to NJDEP.

Mandatory New Jersey Hg Minimization Plan

- Effective April 3, 2007
- All owners/operators of iron or steel melters are required to submit an *Hg Minimization & Source Separation Plan* to NJDEP.

- Including
  - Obtain and maintain a copy of the procedures used by the scrap supplier for assuring Hg switches have been removed.
  - Materials Acquisition Plan (specifying purchase of only Hg free scrap or scrap from scrap suppliers who remove accessible Hg switches.)

What Impact Does This Regulation Have On Atlantic States?

- Mercury emission reduction from approximately 52 lb/yr (actual) to no more than 13 lb/yr
- By January 3, 2010

…or sooner…

Why Now?

- It was decided to eliminate the problematic wet scrubber (reduce operating cost, water issues, increase gas capacity, lower emissions, etc.)
- Combine work with MACT baghouse upgrade
- Save future retrofit costs
- 2010 will be here soon enough, no sense in procrastinating
- Be a “Good Neighbor”

Plant Overview

- 108” hot blast unlined cupola, O_2 injection
- Upper stack combustor, natural gas– afterburners
- Drop out box grit and fly ash removal
- Water spray cooling
- Escher 1,000ºF recuperator
- (NEW) Würz thermal oil gas cooler with continuous “ball rain” cleaning of heat exchanger tubes
- (NEW) Triple reagent addition with LIW low flow injectors
- (NEW) Lühr Dry Gas Sorption Reaction Chamber/KUV recycle
- (NEW) Lühr flat filter baghouse, off line pulse jet cleaning
- Continuous Emission Monitor (CEM) for O_2, CO compliance (NJDEP requirement)
- (NEW) Continuous Mercury Process Monitor

New Source Compliant MACT
Gas Handling System/Baghouse Specifications

- Design Volume - 55,000 SCFM (nom)
- 6,020 flat bags
- Filter area - 59,772 ft^2
- Air to Cloth Ratio – 1.1 to 1.3 ft/min
- Guarantee of 0.002 gr/dscf
- Exhaust - High eff. airfoil – 700 HP, VFD
- Thermal Oil Capacity – 5,300 Gallons
- BH Inlet Gas Temperature – 280° - 290°F
- Dust Recirculation Rate (KUV Recycle) – 10:1

The Function and Operation of the Mercury Control System

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A Successful Startup "The First Year"

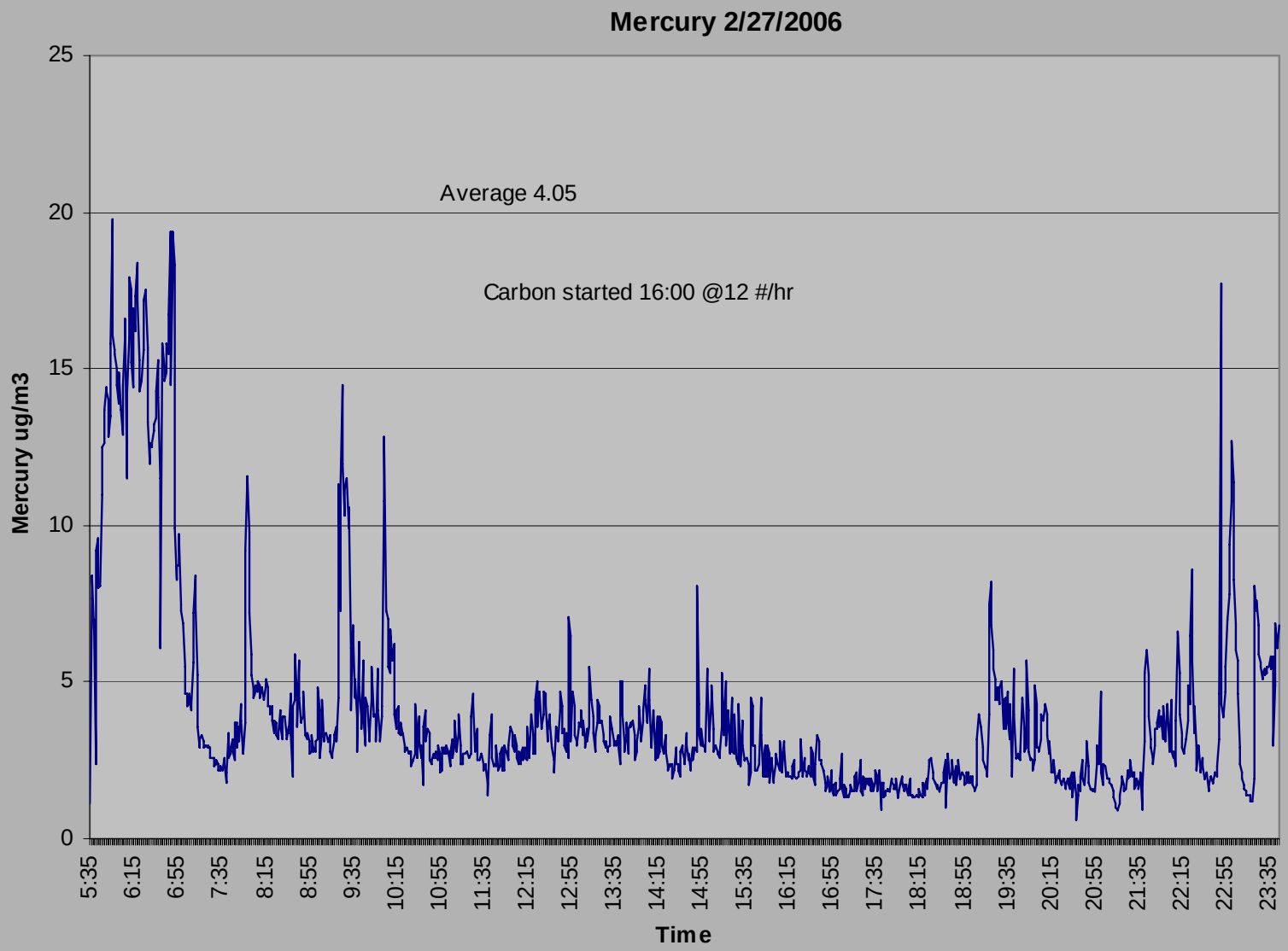
- Commissioned on schedule January 9, 2006
- Goals accomplished in first year
  - System successfully debugged
  - Mercury process monitor made operational
  - Activated carbon addition rate optimized
  - $NaHCO_3$ addition rate optimized
  - Successfully performed stack test for all regulated emissions – in compliance

Hg Activation & Adsorption
How It Works!!

- Powdered activated carbon (PAC) injected upstream of baghouse
- Carbonaceous particles have an affinity with SO_2 molecules in the flue gas
- The SO_2 preconditions the PAC for collection of the metallic Hg
- PAC's open pore structure and fine size permit rapid Hg adsorption (approx 600 m^3 per gram)
- Baghouse gas inlet temperature must be about 280°F
- Dust recycling rate of 10 to 1
- Recycled dust loading at collector inlet 10 to 50 times higher than flue gas for contact
- PAC injection rate of 12 lbs/hr (cost - $7.08/hr)

Hg Process Monitor Measuring Principle

- Sample drawn from stack through a heated line
- Sample passes through a 400ºC heated filter
- Hg is thermally desorbed and PM is removed
- Sample passes through a heated catalyst, forming elemental mercury
- Sample gas is chilled to 3ºC to remove moisture
- Conditioned sample gas enters UV photometer
- Mercury concentration is quantified to ug/m^3


Mercury 2/27/2006
Average 4.05
Carbon started 16:00 @12 #/hr
Mercury ug/m3
0
5
10
15
20
25
5:35
6:15
6:55
7:35
8:15
8:55
9:35
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23:35
Time

Hg Process Monitor Evaluation

Date	Duration	Monitor Avg. ug/m3	Stack Test ug/m3	Stack Test E.F. mg/ton	Activated Carbon
12-Apr-06	124	5.7	26	54.09	OFF
13-Apr-06	131	3.56	4.1	7.78	ON
13-Apr-06	132	6.11	18	46.59	OFF

Stack Test Completed

- Stack test run on December 5, 2006
  - Three test runs, two hours each
- Scrap metal avg. charged = 65.6 tons/hr

Mercury Stack Test Results

- Stack test results avg. = <0.00029 lbs/hr
  - 1st run = <0.00036 lbs/hr
  - 2nd run = <0.00025 lbs/hr
  - 3rd run = <0.00026 lbs/hr
- Hg emission factor less than 2 mg/ton compared to the regulatory limit of 35 mg/ton or 75% removal

Successful Mercury Removal Demonstrated

- Reduced Hg emissions from 0.029 lbs/hr (with scrubber) to less than 0.00029 lbs/hr
- This is a two orders of magnitude reduction
- Greater than 99% removal of Hg from its emissions compared to the wet scrubber
- Based upon 2006 production, Atlantic States has already removed over 50 lbs of Hg from its emissions in the first year of operation of the new system

What Did Atlantic States Achieve Based Upon Stack Test With MACT Baghouse & Hg Controls?

- Will remove 200 lbs Hg voluntarily by 2010
- Reduced CO by 95%
- Reduced TSP by 90%
- Reduced PM-10 by about 60%
- Reduced metals (As, Cd, Cr, Pb)
- Decreased Pb from 0.36 lbs/hr actual to 0.00039 lbs/hr and reduced Hazard Index to negligible level

What Else Did Atlantic States Achieve?

- Reduced natural gas use (MCF/Ton Pipe) by 5.5% thus reducing NOx, CO and CO2
- Reduced electricity consumption by 9.3% thus reducing NOx, CO, and CO2
- Eliminated fan upsets and associated citizen complaints to the NJDEP
- Improved dispersion from higher stack temp
- Reduced waste disposal by approx. 20 tons per day

What Else Did Atlantic States Achieve (cont.)

- Achieved new source MACT standards for the cupola/afterburner
  (Avg. PM 0.0016 gr/dscf < 0.002 gr/dscf)
- Reduced offsite noise (elimination of the high-pressure scrubber fans)
- Reduced occasional odor associated with the former scrubber plume
- Eliminated visible steam plume for the first time since 1856

…BEYOND COMPLIANCE…

Thank you for your attention!

For more information please click here, or visit:

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