United States Environmental Protection Agency

Final Portland Cement Rule 2013

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Keith Barnett
Office of Air Quality Planning and Standards
Sectors Policies and Programs Division
Minerals and Manufacturing Group

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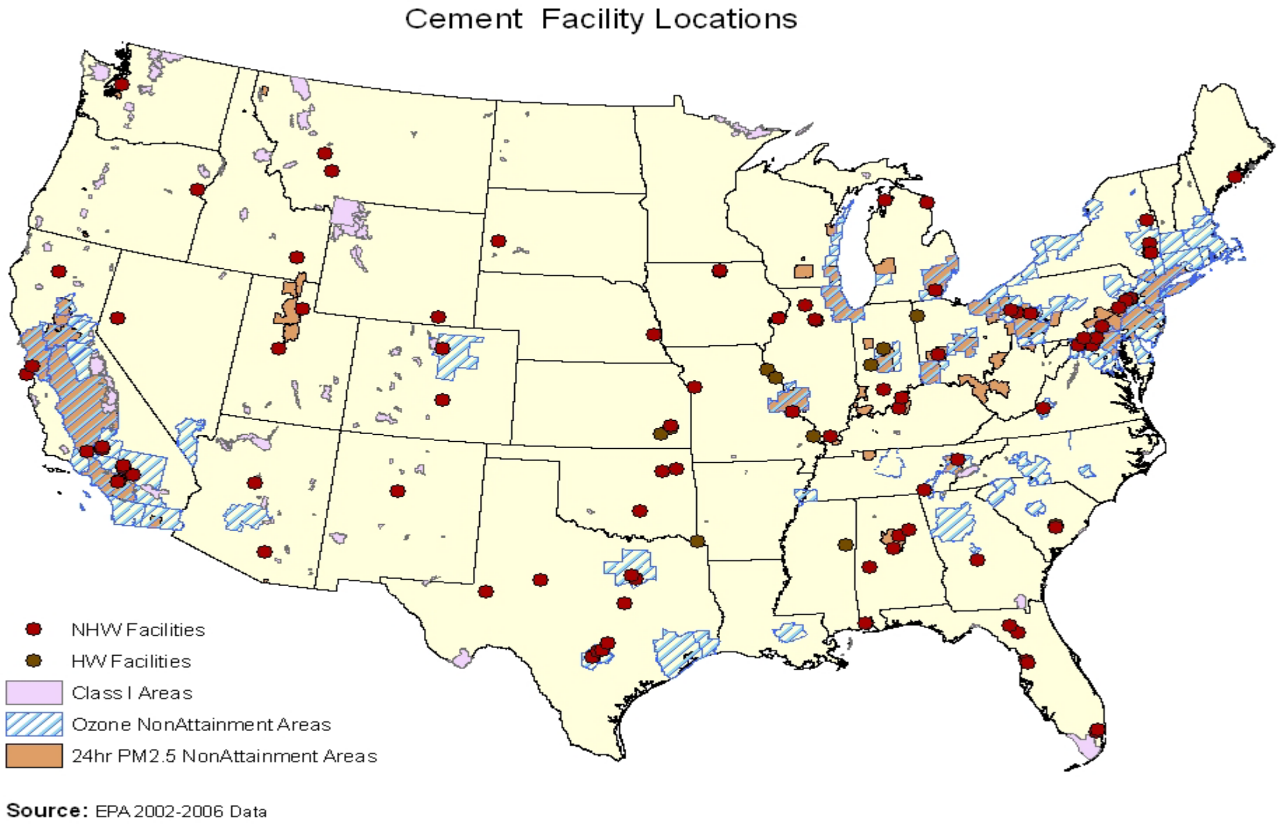
Overview

- Industry Background
- Emission Limits
- Control Technologies
- Expected Emission Reductions
- Mercury Emission Causes
- Development of Mercury Standard
- Questions

Industry Background

2009: 107 Facilities (77 major, 16 area, 14 hazardous waste) comprised of 170 kilns (147 non-hazardous waste kilns)
Projected growth: 6 new kilns by 2013



Pollutant	Annual Emissions in 2002 (tons/yr) All types of kilns
CO_2	81.4 million
PM	37,000
SO_2	159,000
NOx	219,000
CO	150,000
Organic HAP	3,700
HCl	4,507
Hg	7

Data from 2002 U.S. EPA National Emissions Inventory

MACT Standard

- MACT for new sources must be at least as stringent as the emission reduction achieved by the best performing similar source
- Existing source MACT standards must be at least as stringent as the emission reductions achieved by the average of the top 12 percent best controlled sources
- Setting a MACT standard is a two step process:
  - The "MACT floor" is established based on what is currently achieved by sources – costs may not be considered
  - EPA may regulate "beyond the floor" where justified – costs and other issues must be considered
- In Portland cement rule, only four standards were considered – hydrogen chloride (HCl), mercury, particulate matter (PM) and total hydrocarbon (THC)
- Eight years after we set MACT standards, we must review the standards for remaining risk and changes in technology

Existing Cement Kilns Emission Limits

Pollutant	Cement Kilns Burning Traditional Fuels	Cement Kilns Burning Non-Hazardous Waste	Cement Kilns Burning Hazardous Waste
Mercury	55 lb/MM tons clinker (~ 0.010 mg/dscm) (30 day avg)	0.011 mg/dscm	0.12 mg/dscm (with an additional limit on the concentration of Hg in the hazardous waste)
THC (surrogate for Organic HAP)	24 ppmv for all kilns (30 day average)		20 ppmv (hourly rolling avg) or 10 ppmv in a bypass duct
PM (surrogate for nonmercury metal HAP)	0.07 lb/ton clinker via PCMS compliance	4.6 mg/dscm	64 mg/dscm
HCl	3 ppmv	3.0 ppmv	120 ppmv (includes Cl_2)
SO_2	If source has a modification:	600 ppmv	
NO_X	If source has a modification:	630 ppmv	
CO		110 ppmv (long kilns)/ 790 ppmv (preheater/precalciner)	100 ppmv (hourly rolling avg)
Pb		0.014 mg/dscm	0.18 mg/dscm (combined
Cd		0.0014 mg/dscm	limit for Pb + Cd)
Dioxins, Furans, total		1.3 ng/dscm	0.054 mg/dscm
Dioxins, Furans, TEQ	0.2 ng TEQ/dscm	0.075 ng TEQ/dscm	0.2 ng TEQ/dscm

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New Cement Kilns Emission Limits

Pollutant	Cement Kilns Burning Traditional Fuels	Cement Kilns Burning Non-Hazardous Waste	Cement Kilns Burning Hazardous Waste
Mercury	21 lb/MM tons feed (30 day average)	0.0037 mg/dscm	0.12 mg/dscm (with an additional limit on the concentration of Hg in the hazardous waste)
THC (surrogate for Organic HAP)	24 ppmv for all kilns (30 day average)		20 ppmv (hourly rolling avg) or 10 ppmv in a bypass duct
PM (surrogate for nonmercury metal HAP)	0.02 lb/ton clinker via PCMS compliance	2.2 mg/dscm	16 mg/dscm
HCl	3 ppmv	3.0 ppmv	86 ppmv (includes Cl_2)
SO_2	0.4 lb/ton clinker	28 ppmv	
NO_X	1.50 lb/ton clinker	200 ppmv	
CO		90 ppmv (long kilns)/ 190 ppmv (preheater/precalciner)	100 ppmv (hourly rolling avg)
Pb		0.014 mg/dscm	0.33 mg/dscm (combined
Cd		0.0014 mg/dscm	limit for Pb + Cd)
Dioxins, Furans, total		0.51 ng/dscm	0.056 mg/dscm
Dioxins, Furans, TEQ	0.2 ng TEQ/dscm	0.075 ng TEQ/dscm	0.2 ng TEQ/dscm

Control Technologies

Control Type	Pollutants	Maximum Estimated Control Efficiency	Number of projected installations [c]
Lime Injection	HCl	70 %	2
Limestone Wet Scrubber	Mercury HCl SO_2	Mercury – 80 % HCl – 99.9 % SO_2– 90 %	59-117
Activated Carbon Injection[a]	Mercury THC/Organic HAP	Mercury – 90 % Organic HAP – 80 %	71-153
Regenerative Thermal Oxidizer[b]	THC	98 %	10-21
Membrane Bags added to existing fabric filter	PM and HAP metals	>99.9 %	6-28
Fabric Filter	PM and HAP metals	>99.9 %	0-2
Selective NonCatalytic Reduction	NOx	50-60 %	7
Selective Catalytic Reduction	NOx, but expect Dioxin, THC cobenefits	70-90 %	1 under construction (Joppa, Illinois)

[a] Includes a second fabric filter for carbon capture
[b] May require a wet scrubber upstream for acid gas removal
[c] Based on an estimated population of about 153 kilns. This includes kilns burning nonhazardous waste but not kilns burning hazardous waste. Many kilns may require multiple controls

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Expected Emission Reductions

Cement Kilns Burning Traditional Fuels

	Mercury (lb/yr)	HCl (tons/yr)	PM (tons/yr)	THC (tons/yr)
Baseline Emissions	13,912	3,697	9,267	9,395
Reductions from Rule	12,909	3,541	8411	7,731
Percent Reductions	93	96	91	82

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Mercury Emission Causes

- Mercury emissions from a Portland cement plant come from the cement kiln
- Mercury is present in trace quantities (typically parts per billion) in the raw materials and fuels
- The mercury volatizes in the kiln and is emitted mainly as a gas
- Little or no mercury leaves the kiln as part of the clinker
- Some mercury condenses on the particulate and is captured in the kiln PM control
  - The material captured in the PM control is typically returned to the kiln and the mercury is reemitted as a result

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Data Gathering

- In 2007 EPA obtained the following information for 89 kilns:
  - 30 days of mercury concentration data for all kiln fuel and raw materials
  - Annual or daily fuel and raw material use
  - 30 days of mercury concentration data for cement kiln dust
  - All mercury emission tests
  - Information on kiln capacity, design and air emissions controls for PM, SO_2 and NOx
- Most kilns in the United States had no mercury controls at that time
  - Five kilns had limestone wet scrubbers to remove mercury in addition to SO_2
  - One kiln had pilot-tested activated carbon injection (ACI) and was installing a full scale system
  - Some kilns waste cement kiln dust to control chloride content of the clinker
- Performed inlet/outlet mercury testing on five limestone scrubbers installed for SO_2 control
  - Test results showed the scrubbers removed up to 80 percent of the total mercury

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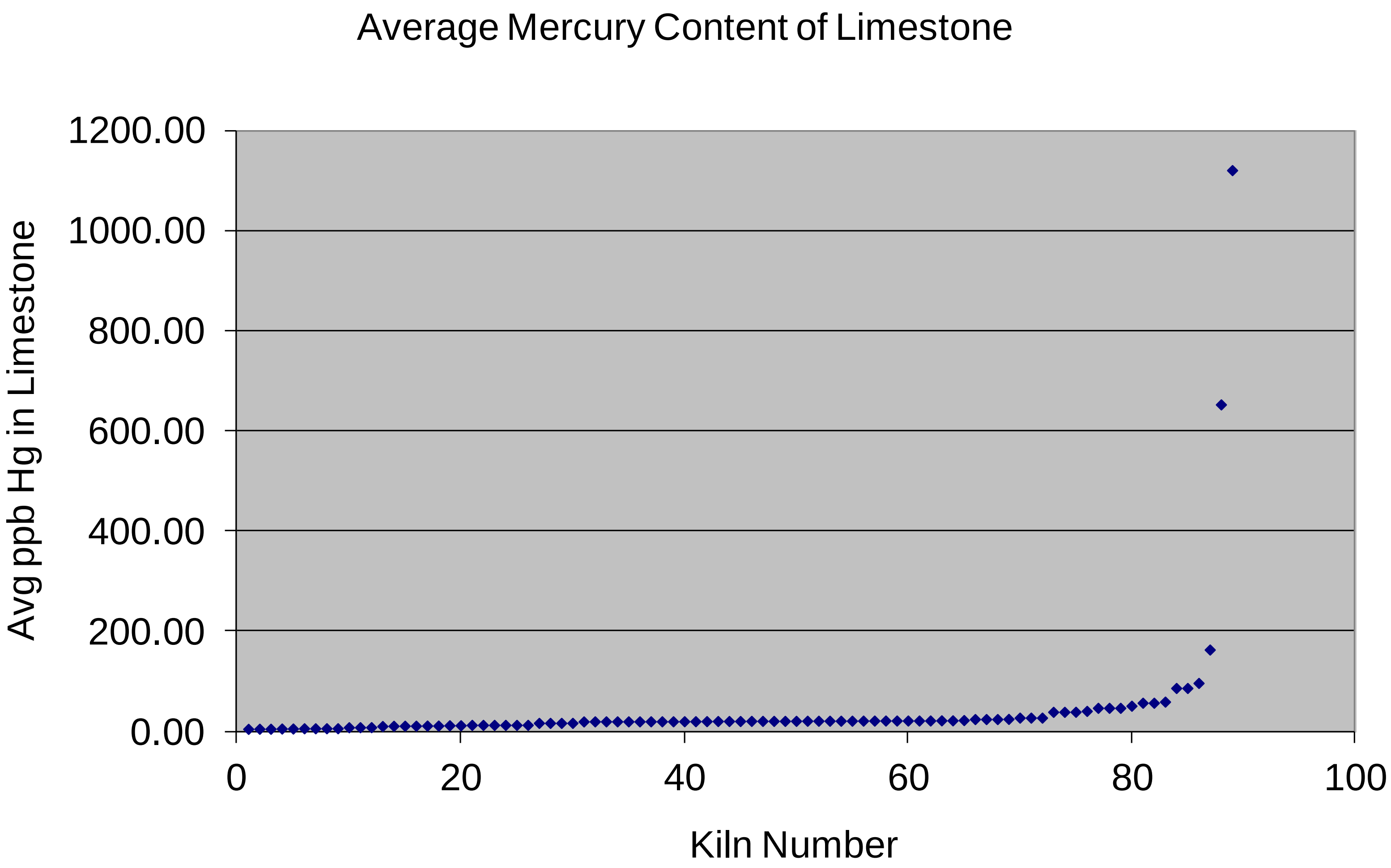
Results of Mercury Emission Analysis

- Results of the 89 kilns in our survey
  - Total mercury inputs (89 kilns) were 11,490 lbs/yr
  - Total mercury emissions (89 kilns) were 10,360 lb/yr
- The limestone feed is the largest single source of mercury on a mass basis
- However, limestone feed represents approximately 75 percent of the total mass input to the kiln but contributes only 46 percent of the mercury input
- On a per unit basis, the additives (non-limestone raw materials) and fuels can be important
- The normalized emission rates range from 2 to 300 lb mercury per million tons of feed. The average is 70 and the median is 55
- The mass emission rates per kiln range from less than one pound to 345 lb per year, with an average of 65 and a median of 40
- There are two kilns that have significantly elevated emission rates (1700 and 2900 lb/year) compared to all other kilns. The elevated emissions are due to a specific high mercury rock formation in the western United States

Limestone Mercury Contents



Development of Mercury Standard

- The kiln mercury input data were used to develop long term mercury emission profiles, assuming mercury emissions equal mercury inputs (unless the kiln had mercury controls)
- In developing the limit, EPA accounted for the inherent variability of the mercury content of raw materials
- Other than emission testing limestone wet scrubbers, we did not perform any research on mercury controls
- We also obtained information on the performance of a full scale ACI system and dust shuttling
  - The ACI system reached mercury removal levels as high as 95 percent
  - At one site dust shuttling reduced raw mill off mercury emissions from ~400 ug/dscm to ~ 20 ug/dscm
- The current standard includes a requirement for continuous mercury emissions monitoring
  - Our data indicate that short term tests may not accurately predict long term emissions – especially if the kiln has an inline raw mill

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Questions?

- US EPA air regulations and technical information for cement industry: http://www.epa.gov/airquality/cement/

- Fact sheet for most recent rule actions: http://www.epa.gov/airquality/cement/pdfs/20121220_port_cement_fin_fs.pdf

- Full Text of Portland Cement regulations for Mercury:

  http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&SID=29de26dfc6edc2f3b162d26974a89f27&rgn=div6&view=text&node=40:12.0.1.1.1.8&idno=40