Boiler MACT Coal Sampling

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3Q CIBO Meeting

Outline

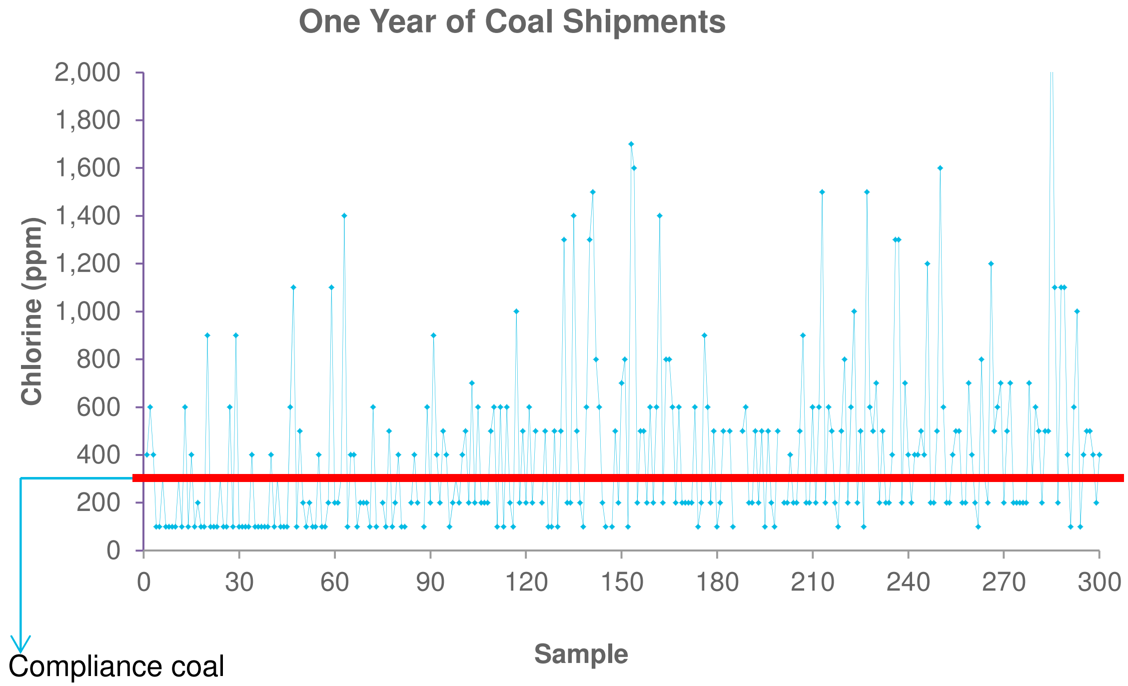
- Fuel Analysis Plans

- Initial Compliance
  - Performance Testing
  - Fuel Analysis
  - Emissions Averaging

- Continuous Compliance
  - Performance Testing
  - Fuel Analysis
  - Emissions Averaging

Step 1

KNOW YOUR FUELS!



Spot checking can get you in trouble

Adding Cl and Hg to your coal's short prox is cheap

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FUEL ANALYSIS PLANS

Fuel Analysis Plans
63.7521(b)

- Only required to “develop” the plan if following methods listed in Table 6
- Must submit to Administrator for “review and approval” to use alternative analytical methods.
  - Submit no later than 60 days before initial demonstration
- Must include
  - All fuel types anticipated to be burned
  - Who will be conducting fuel analysis
  - Sample location
  - Analytical methods with expected minimum detection limits
  - If using alternative, detailed description of methods and procedures you are proposing to use.
  - If fuel supplier is doing analysis, they must use methods listed in Table 6

Fuel Sample Collection
63.7521(c)

- At a minimum, collect 3 composite samples
  - Separated by 1-hr during a performance test
  - Separated by approximately equal 10-day intervals when doing monthly samples.
- 63.7521(c) lists various methods of sample collection. Can also use various ASTM methods found in Table 6.
- For the rest of this presentation, let's assume that we grabbed the following 3 samples

Sample	BTU/lb	Chlorine (ppm)	Chlorine (lb/MMBTU)	BMACT Limit (lb/MMBTU)
1	12,800	500	0.039	0.022
2	13,200	100	0.008	
3	13,000	200	0.015	

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DEMONSTRATING INITIAL COMPLIANCE

Initial Compliance Demonstration
Comply by Performance Testing – 63.7530(b)

- Conduct fuel analysis during stack test
  - Unless you are burning a single fuel, then no analysis required
- If you are burning multiple fuels, this sets the highest pollutant content that your fuel mixtures can have.
- If you are burning a single fuel, this just limits the fuel *type* that you can burn.

- $Cl_{Input} = \sum_{i=1}^{n}(Cl_i \times Q_i)$
- Cl_{Input}=Max Chlorine entering boiler (lb/MMBTU)
- Cl_i=**Arithmetic average** of Cl in fuel type, i (lb/MMBTU)
  - From samples taken during performance test
- Q_i=Fraction of total heat input from fuel type, i

Initial Compliance Demontration
Performance Testing – Do you need a fuel analysis?

- 63.7510(a)(2)(i) – No fuel analysis required if you burn a single fuel, excluding ignitors.
- 63.7510(a)(2)(ii) – Cofired NG, refinery gas, or other gas 1 fuels do not require analysis
- 63.7520(c) – "Conduct performance test…while burning the *type* of fuel or mixture of fuels that has the highest content of chlorine and mercury and TSM"
- 63.7530(b)(1)(i) – Use "fuel *type* or fuel mixture that you could burn…that has the highest content of chlorine [or mercury]"

- Example: Unit can burn three fuels:
  - Coal: Chlorine = 0.04 lb/MMBTU, Hg = 5 lb/TBTU
  - Other gas 1: Hg < 40 mg/m^3
  - Used Oil: Chlorine = 0.01 lb/MMBTU, Hg = non-detect

- Question: Do you need to collect fuel analysis during performance test?

- Answer: NO! During the test, you will only burn coal
  - Therefore, during testing, you are burning a <u>single fuel</u>.

Initial Compliance Demonstration Comply by Performance Test - EXAMPLE

- $Cl_{Input} = \sum_{i=1}^{n}(Cl_i \times Q_i)$

Sample	BTU/lb	Chlorine (ppm)	Chlorine (lb/MMBTU)	BMACT Limit (lb/MMBTU)
1	13,000	200	0.015	0.022
2	13,200	100	0.008	
3	12,800	500	0.039	
Cl_i			0.021	

- Assume coal is only fuel for simplicity, therefore Q_i=1
- Chlorine Input is the arithmetic average of the 3 samples.
- The average chlorine the fuel is 0.021 lb/MMBTU
  - If you burned multiple fuels, this would be your maximum chlorine input level
  - This CAN be greater than 0.022 lb/MMBTU if your stack test shows less than 0.022 lb/MMBTU.

Initial Compliance Demonstration
Comply by Fuel Analysis – 63.7530(c)

- Determine fuel mix resulting in maximum emission rates
- Determine 90th percentile confidence level fuel pollutant concentration

- P90=mean + (SD x t)
- P90 = 90th percentile confidence level pollutant concentration (lb/MMBTU)
- Mean = Arithmetic average of pollutant concentration in fuel samples (lb/MMBTU)
- SD = Standard deviation of pollutant concentration (lb/MMBTU)
- t= t distribution critical value for 90th percentile ($t_{0.1}$) probability for the appropriate degrees of freedom (number of samples minus one) as obtained from a t-Distribution Critical Value Table

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Initial Compliance Demonstration
Comply by Fuel Analysis – 63.7530(c)

- After calculating P90 for each fuel, use the following formula

- $HCl = \sum_{i=1}^{n}(C_i 90 \times Q_i \times 1.028)$

- HCl = HCl emission rate (lb/MMBTU)
- $C_i 90$ = 90th percentile confidence level concentration of Cl in fuel type, i, as calculated by the P90 formula
- Q_i=Fraction of total heat input from fuel type, i
- 1.028 = Molecular weight ratio of HCl to chlorine

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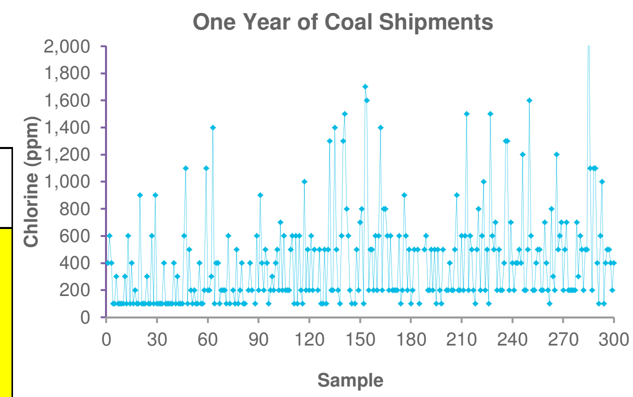
Initial Compliance Demonstration Comply by Fuel Analysis – EXAMPLE

- P90=mean + (SD x t)
- $HCl = \sum_{i=1}^{n}(C_i 90 \times Q_i \times 1.028)$



	BTU/lb	Chlorine (ppm)	Chlorine (lb/MMBTU)	BMACT Limit (lb/MMBTU)
1	13,000	200	0.015	
2	13,200	100	0.008	
3	12,800	500	0.039	
mean			0.021	0.022
SD			0.016	
t			1.886	
P90			0.052	
HCl			**0.053**	

n-1

t-Dist. Table	
No. Samples	0.1
1	3.077684
2	**1.885618**
3	1.637744
4	1.533206
5	1.475884

- Assume coal is only input for simplicity, therefore Q_i=1
- Your average HCl shows compliance, but the P90 calculation shows that you are more than double the limit.
  - YOU ARE OUT OF COMPLIANCE!
  - Consider Performance Testing

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Initial Compliance Demonstration
Comply by Emissions Averaging– 63.7522(e)

- Initial demonstration for emissions averaging can use a combination of Performance Testing and Fuel Analysis
- WATCH OUT – Initial demonstration requires compliance based on RATED heat input, not actual.

- $AveWeightedEmissions = 1.1 \times \frac{\sum_{i=1}^{n}(Er \times Hm)}{\sum_{i=1}^{n} Hm}$
- Er = Emission rate (as determined during the initial compliance demonstration) of pollutant from unit, i, in lb/MMBTU. Determine Er by performance testing or by fuel analysis.
  - Note: Rule refers back to the P90 equations for fuel analysis
- Hm = MAXIMUM rated heat input capacity for unit, i, in MMBTU/hr
- n = Number of units participating in emissions averaging option
- 1.1 = Required discount factor.

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DEMONSTRATING CONTINUOUS COMPLIANCE

Continuous Compliance Demonstration
Comply by Performance Testing – 63.7540(a)(2)

- Ensure all fuel *TYPES* and mixtures of fuels burned would result in lower fuel input of Cl, Hg, TSM than the maximum values calculated during last performance test.

- The rule does NOT say to verify that the fuel TYPE that you used during performance testing will not be higher than the calculated maximum values.
  - In other words, take the "Highs" with the "Lows"

- You were responsible for knowing the Cl, Hg, TSM of your fuels before the performance test so that you could pick the worst case fuel mix.
  - Remember Step 1: KNOW YOUR FUELS!

Continuous Compliance Demonstration Comply by Fuel Analysis – 63.7512(e) & .7540(a)

- Collect monthly fuel samples for analysis.
  - 63.7512(e) says can collect anytime during the month as long as separated by at least 14 days from previous sample
  - 63.7521(c)(1)(ii) says, “For monthly sampling, each composite sample shall be collected at approx. equal 10 day intervals during the month.
- Can decrease to quarterly if 12 consecutive months are <75% of compliance level
- Use the following equation to calculate the monthly average then compute 12 month rolling average (Table 8)

- $Cl_{Input} = \sum_{i=1}^{n}(Cl_i \times Q_i)$
- Cl_{Input}=Chlorine entering boiler (lb/MMBTU)
- Cl_i=**Arithmetic average** of Cl in fuel type, i (lb/MMBTU)
  - From samples taken during the month
- Q_i=Fraction of total heat input from fuel type, i

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Continuous Compliance Demonstration
Comply by Fuel Analysis- EXAMPLE

- $Cl_{Input} = \sum_{i=1}^{n}(Cl_i \times Q_i)$

Sample	BTU/lb	Chlorine (ppm)	Chlorine (lb/MMBTU)	BMACT Limit (lb/MMBTU)
1	13,000	200	0.015	0.022
2	13,200	100	0.008	
3	12,800	500	0.039	
Cl_i			0.021	

- Assume coal is only input for simplicity, therefore Q_i=1
- Chlorine Input is the arithmetic average of the 3 samples.
- The average chlorine the fuel is 0.021 lb/MMBTU which is less than BMACT limit.
- Recall that these 3 samples failed the initial compliance demonstration for fuel analysis since it used P90.

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Continuous Compliance Demonstration Comply by Emissions Averaging – 63.7522(f)

- Each month, use the following equation
- $AveWeightedEmissions = 1.1 \times \frac{\sum_{i=1}^{n}(Er \times Hb)}{\sum_{i=1}^{n} Hb}$
- Er = Emission rate (as determined during most recent compliance demonstration) of pollutant from unit, i, in lb/MMBTU. Determine Er by last performance testing or by current month's fuel analysis.
  - Note: Rule NO LONGER refers back to the P90 equation for units that use fuel analysis.
- Hb = Actual heat input for unit, i, in MMBTU/hr during previous month
- n = Number of units participating in emissions averaging option
- 1.1 = Required discount factor.

- 63.7522(f)(3) – compute a 12 month rolling average.
  - Can begin collecting data 12 months before compliance date to have 12 month average built (give a cushion). There is no provision for this for units complying by fuel analysis that are not part of an emissions averaging program.

Summary / Questions?

		Use Pollutant's	Heat Input, use
Initial Demonstration	Performance Testing	Average	Actual
	Fuel Anlaysis	P90	Actual
	Emissions Averaging	Average if Performance Testing P90 if Fuel Analysis	Rated Maximum
Continuous Demonstration	Performance Testing	Average	Actual
	Fuel Anlaysis	Average	Actual
	Emissions Averaging	Average	Actual

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