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Testing Mercury Sorbents Effectively

Guidelines for Testing

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- Not All Sorbents Are the Same
- Establish a Quality Baseline
- Allow for change over time when testing multiple sorbents
- Allow for proper conditioning time
- Impact of Plant Configuration
- Impact of Test Approach

Understand the Material You are Testing

Material differences	Particle size
	Surface treatment – type and process
Injection differences	Flowability - Out of the silo
	Conveyability - through distribution system
	Density
Plant Interaction	Flue gas composition (SO_3/DSI)
	Equipment interaction

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Establish a Quality Baseline

Coal is a naturally occurring resource and mercury content can vary significantly

Baseline mercury for each test period

- Concurrent with sorbent traps
- Prior to each days injection with CEMS

Allows capability to normalize data for changing conditions

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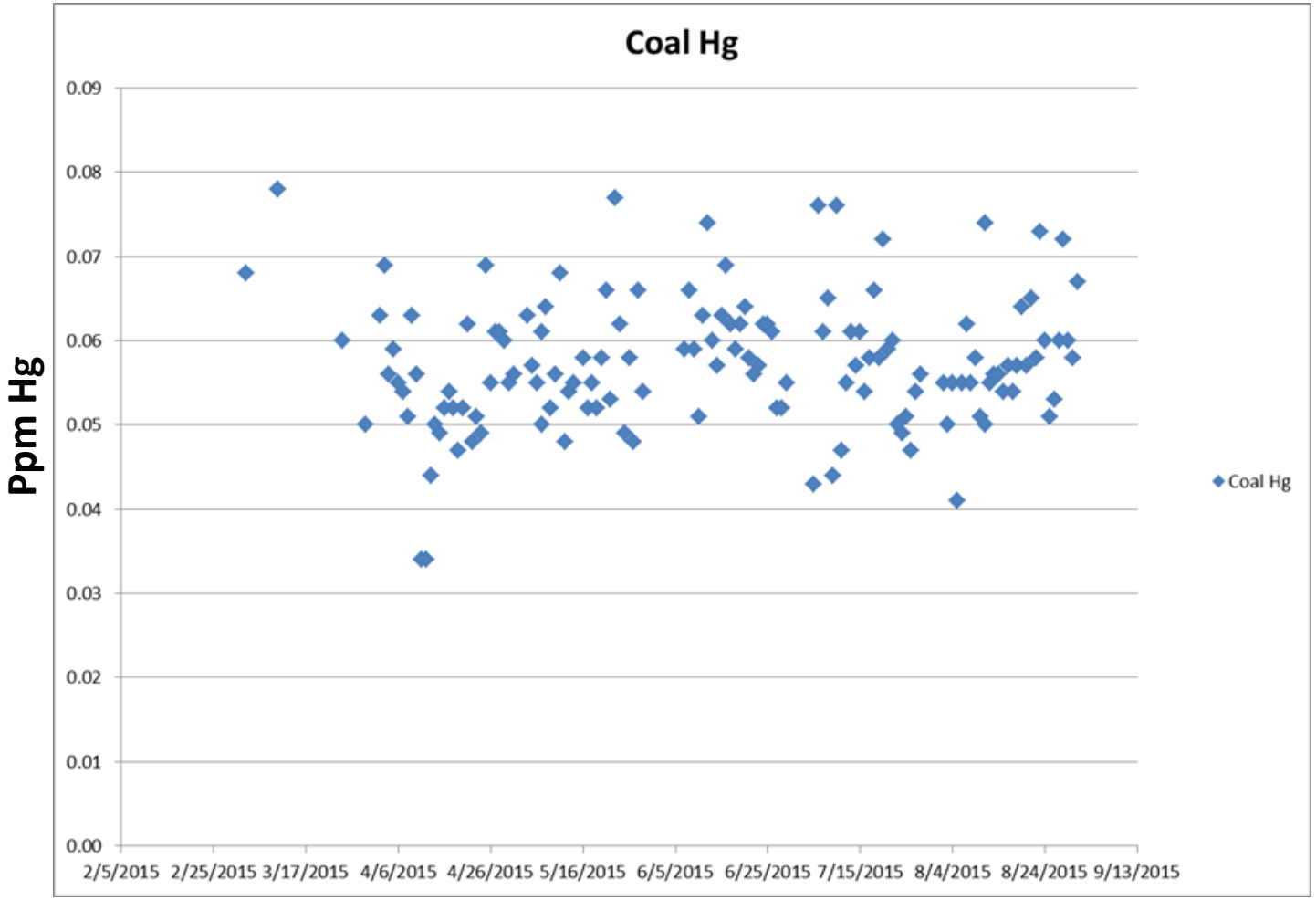
Historic Mercury Content



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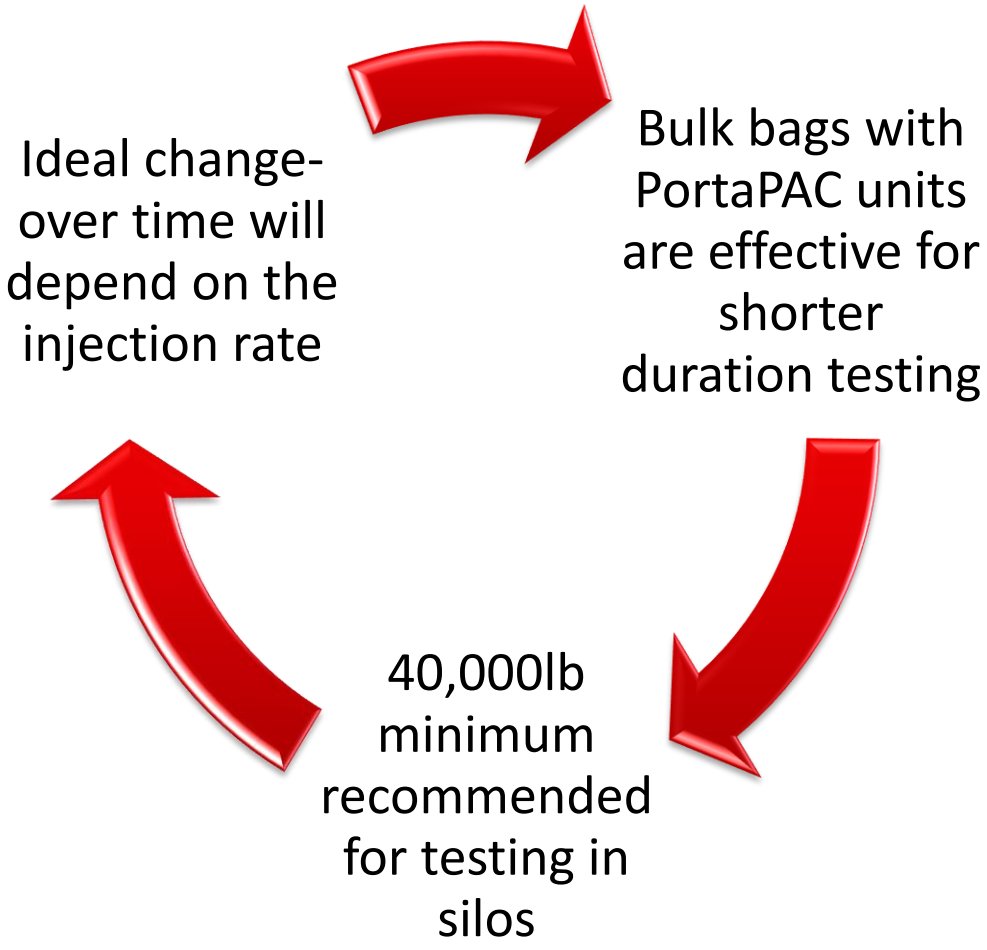
Consider changeover time when switching sorbents inside a silo



Consider changeover time when switching carbons inside a silo

Run the feeders dry before adding fresh carbon

- Up to 15,000lb of carbon can be present below the low level alarm
  - 2 days at 140 kg/hr just to remove old material
- Turbulent environment during filling
- Product mixing zone will be present if the silo is not completely empty

True mass flow doesn't always occur

Make sure the silo is configured for the new carbon - Density

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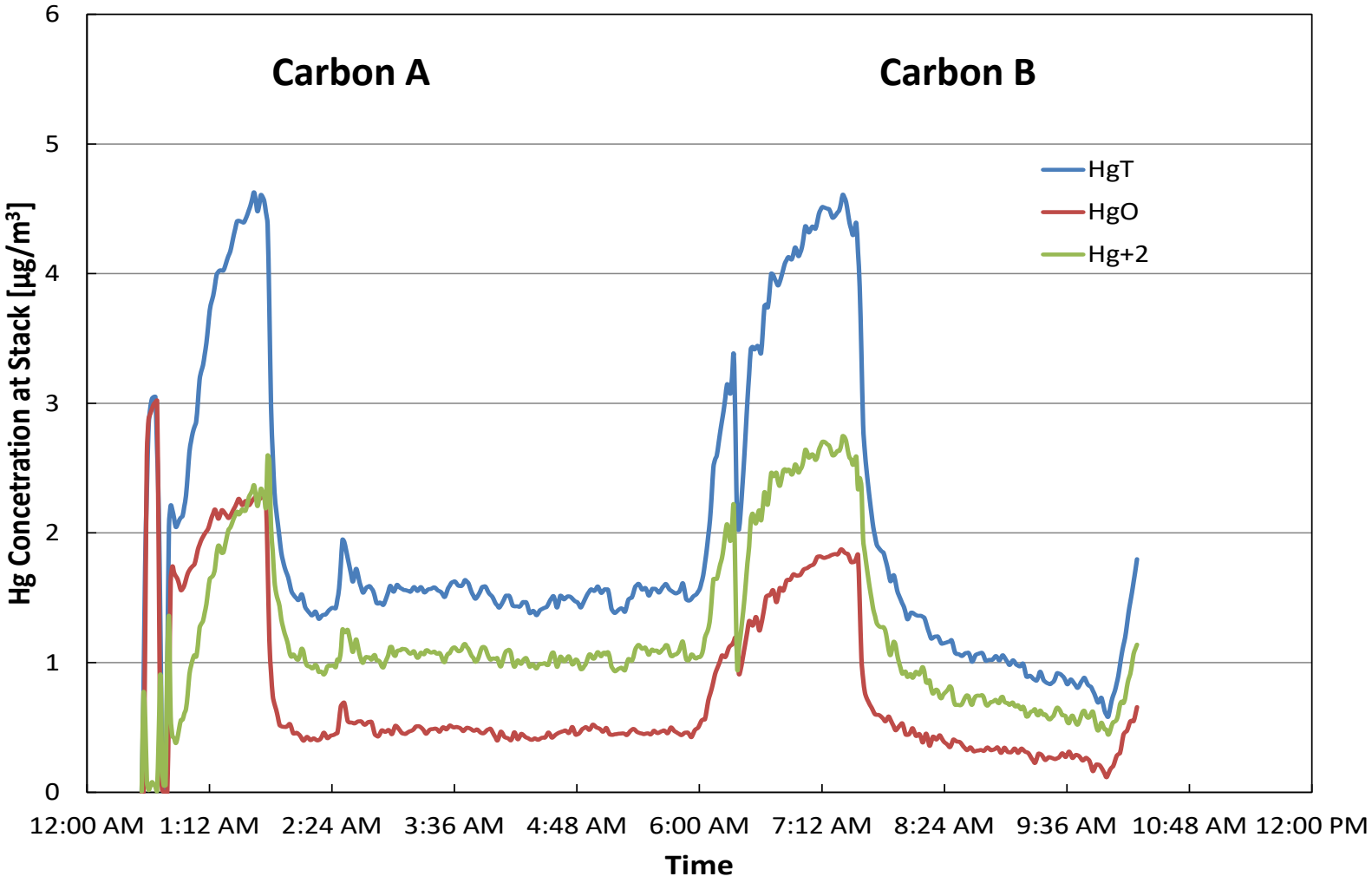
Conditioning Time

- Conditioning time can be defined as the time required to achieve steady state when ANY change in the system is made
- Longer on first introduction of carbon to the system
- Resonance time in the system – Duct length
- Longer for bag house vs ESP
- Wet FGD and SDA may take longer for liquor to acclimate to carbon
  - Changing oxidative profile of Hg that gets past the carbon
- Certain carbons takes longer to condition

Different carbons require different conditioning times



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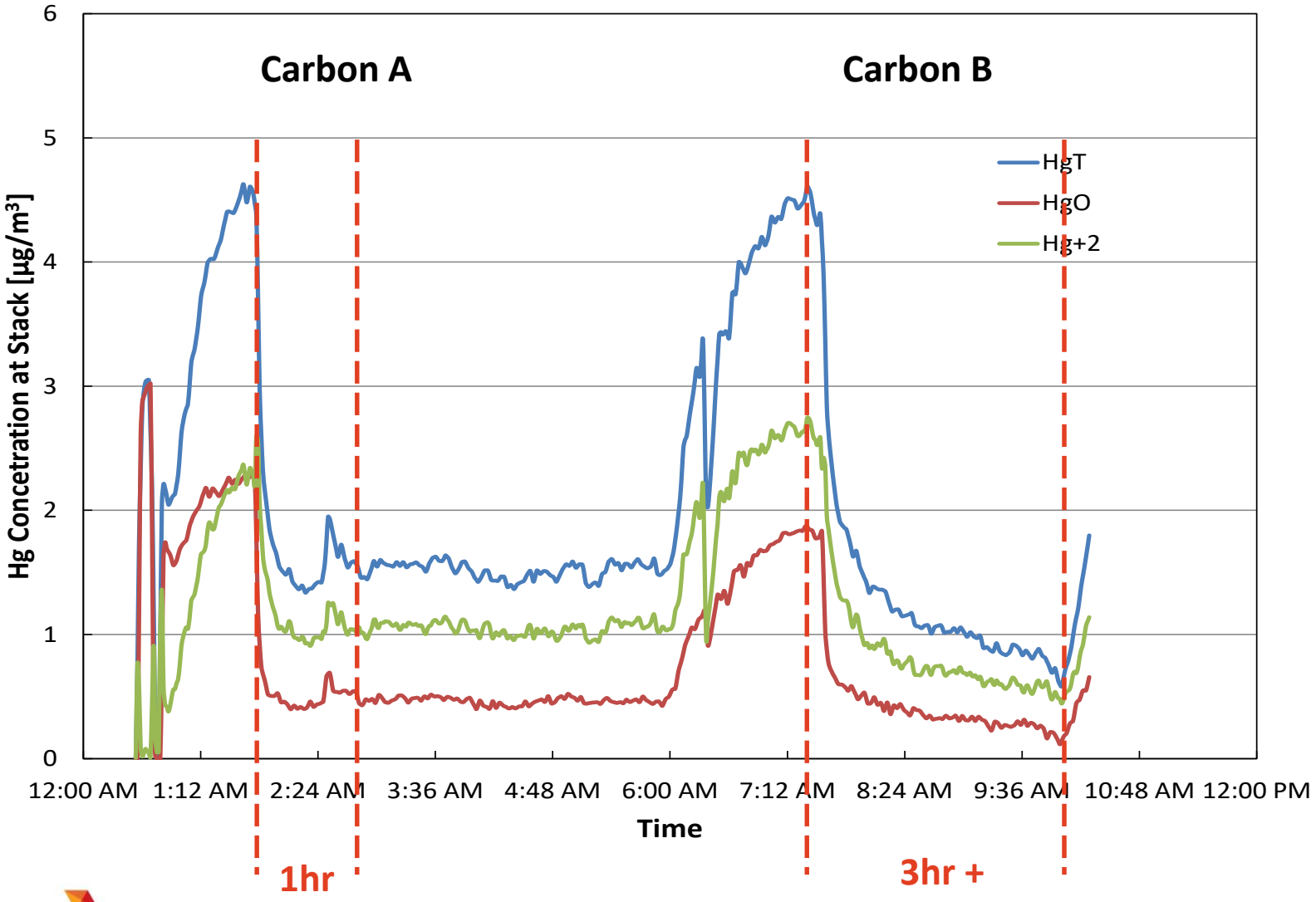
Different carbons require different conditioning times



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What about plant configuration drives carbon performance?

- Flue gas composition
  - Native or injected SO_3 levels
  - Interaction with other dry sorbents
  - All other attributes
- Level of mercury oxidation
  - PAC selection
  - PAC performance
- Time-temperature history
  - Residence time/run length
  - Temperature at injection
  - Bag house vs ESP
- Other environmental control devices

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What about the test approach drives performance?

- Load Stability: 3 hours of stable run time before injection
  - Testing provides a performance snapshot under a certain series of conditions
  - If conditions are changing we lose the ability to directly compare
- Test Point Stability: 3 hours of stable run time before changing conditions
  - Allow the carbon time to fully integrate into the system
  - Different carbons require different stabilization periods
  - System configuration plays a key role as well
  - Traps should be started in the third hour
- Don’t try to do too much in a day
  - 3-4 conditions
  - Change 1 variable
  - Adapt test plan based on daily observations

Testing is expensive so lets make sure we are collecting quality data the first time

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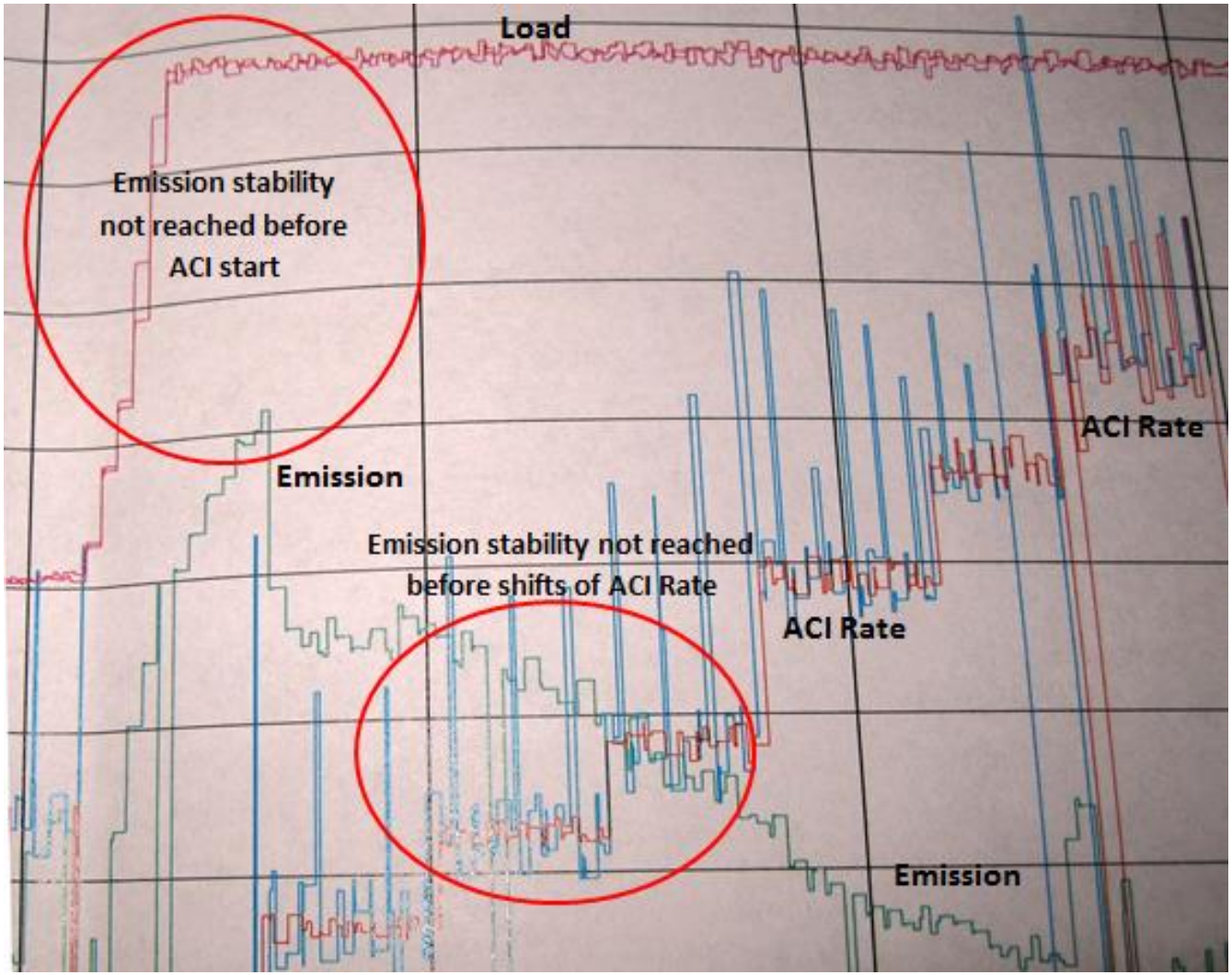
Poorly Designed Test Plan



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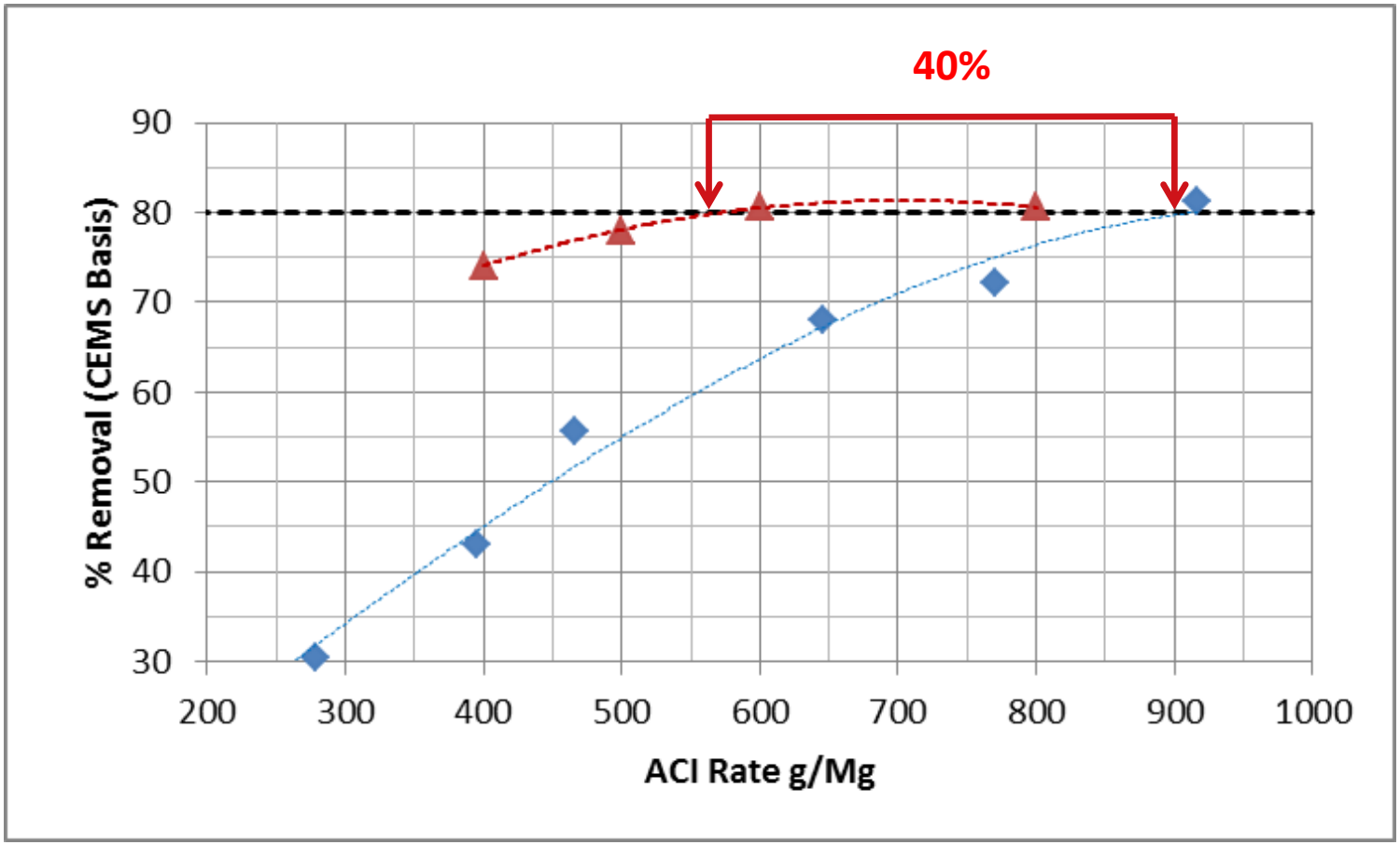
The Value of Conditioning



Moved from 1hr to 3hr conditioning time.

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Sample Daily Test Plan

Time	Condition	Injection Rate	Notes
5:00	Move to full Load Scenario 1	0	-
5:00-8:00	Full Load Scenario 1	0	Collect Baseline 7:00-8:00
8:00-11:00	Full Load Scenario 1	Injection Rate 1	Traps taken 10:00-11:00
11:00-14:00	Full Load Scenario 1	Injection Rate 2	Traps taken 13:00-14:00
14:00-17:00	Full Load Scenario 1	Injection Rate 3	Traps taken 16:00-17:00
17:00	Return to Dispatch	0	

5:00 the following day begin scenario 2

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ICAC White Paper

Institute of Clean Air Companies:

- White Paper: Conducting A successful Mercury Control Demonstration Test At A Coal Fired Power Boiler – 2013

https://cdn.ymaws.com/www.icac.com/resource/resmgr/standards_whitepapers/hg_assessment_final_021513.pdf

Thank You

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Observed effect is called “thermophoresis” Finer particles are more attracted to cold surfaces

- Heat exchangers (such as air preheaters) have temperature gradients in the heating fluid (flue gas)
- Gas adjacent wall is cooled and therefore made more dense
  - Higher density generates a velocity towards the wall and particles are entrained
- All particles are attracted to colder surfaces via this effect
- Smaller particles are more easily entrained (smaller) so the effect of the towards wall velocity is larger