

**McIlvaine Hot Topic Hour**  
**“Dry Sorbent Injection and Material  
Handling for APC”**

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**Siemens Environmental Systems & Services**

## **Environmental Systems & Services**

- Mercury and Air Toxics (MATS)
- Dry Sorbent Injection (DSI)
- Activated Carbon Injection (ACI)
- Injection Systems
- ESP & FF considerations

# Mercury and Air Toxics Standards (MATS)

Parameter	Existing Units	New Units	Compliance
HCl	0.02 lbs/MW-hr <sup>1</sup>	0.01 lbs/MW-hr	CEMS
SO <sub>2</sub> <sup>2</sup>	1.5 lbs/MW-hr	1.0 lbs/MW-hr	CEMS
Hg	0.013 lbs/GW-hr <sup>3</sup>	0.003 lbs/GW-hr <sup>4</sup>	CEMS or Sorbent Trap CEMS

<sup>1</sup> or 0.0020 lb/MMBtu.

<sup>2</sup> SO<sub>2</sub> acceptable surrogate for HCl for plants with FGD and CEMS.

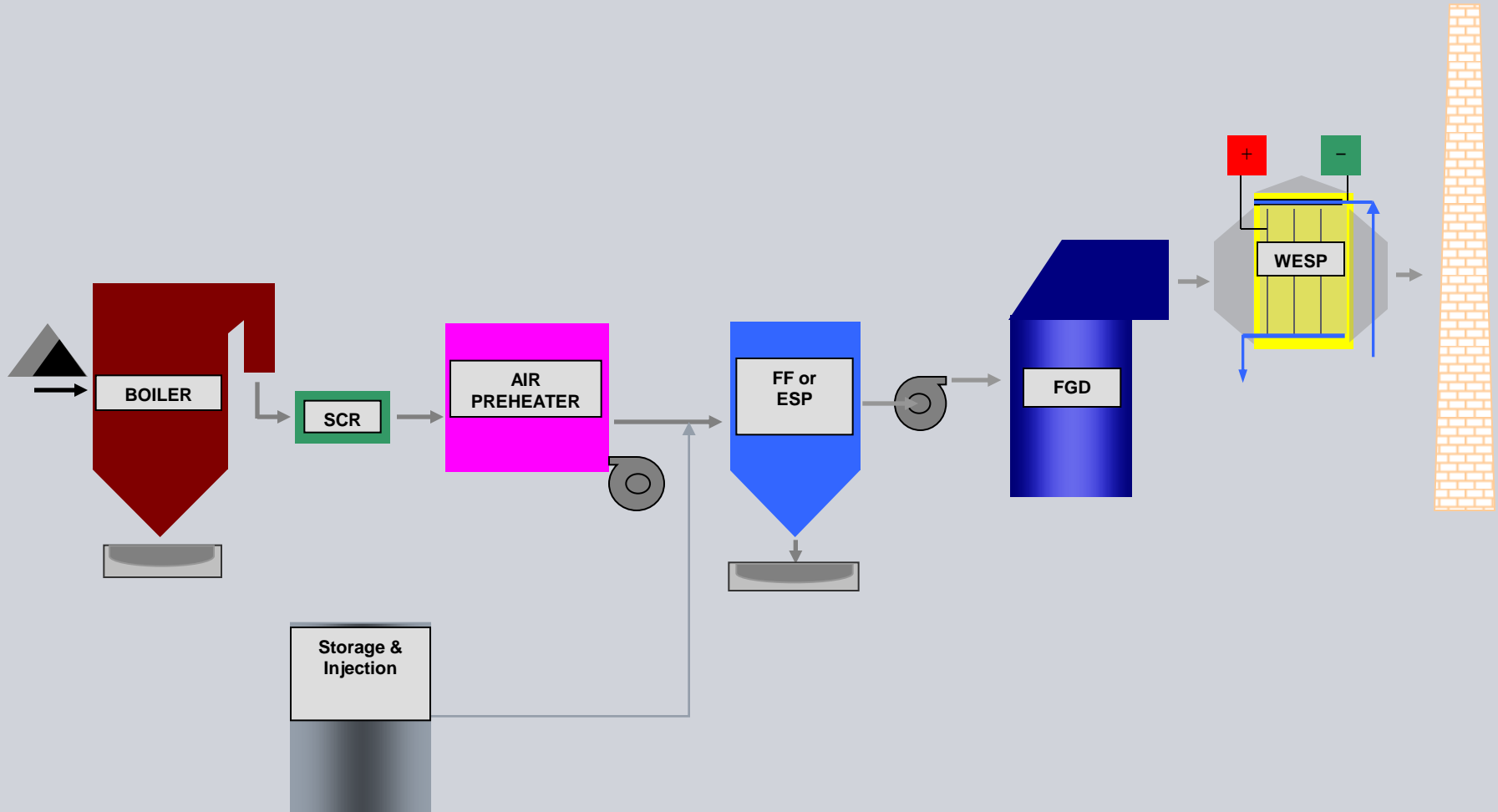
<sup>3</sup> 0.12 lbs/GW-hr for plants firing low rank coal

<sup>4</sup> 0.040 lbs/GW-hr for plants firing low rank coal

## Dry Sorbent Injection

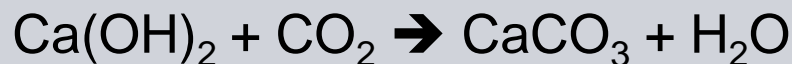
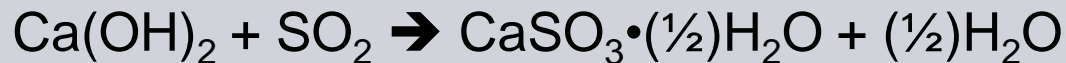
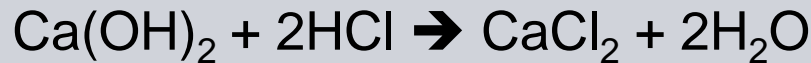
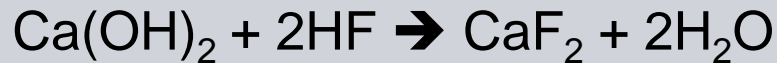
- Hydrated Lime (calcium hydroxide) -  $\text{Ca}(\text{OH})_2$
- Trona (sodium sesquicarbonate) –  $\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{HOH}$
- SBC (sodium bicarbonate) –  $\text{NaHCO}_3$

## Dry Sorbent Injection

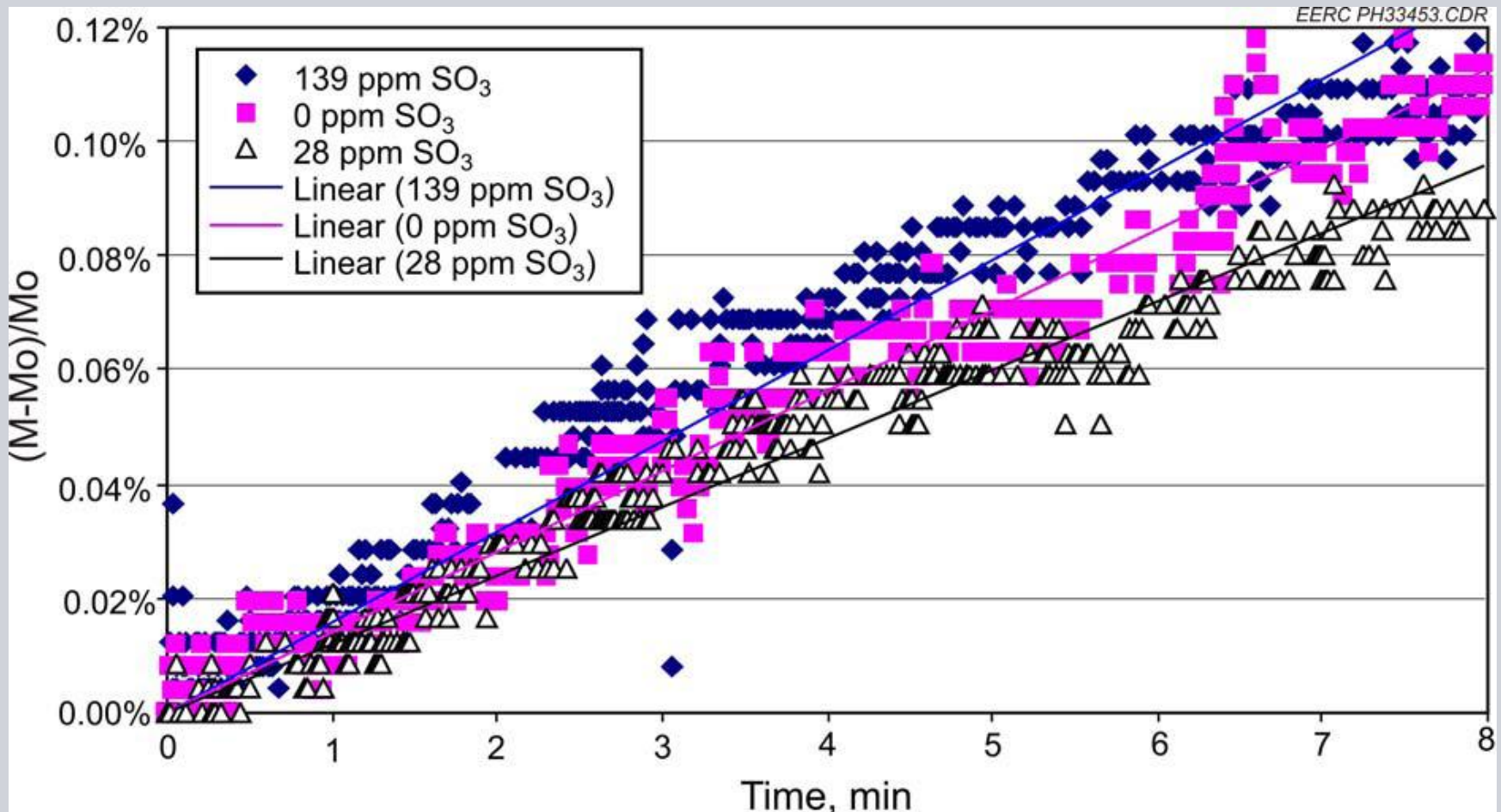


## Dry Sorbent Injection

### Competitive Reactions

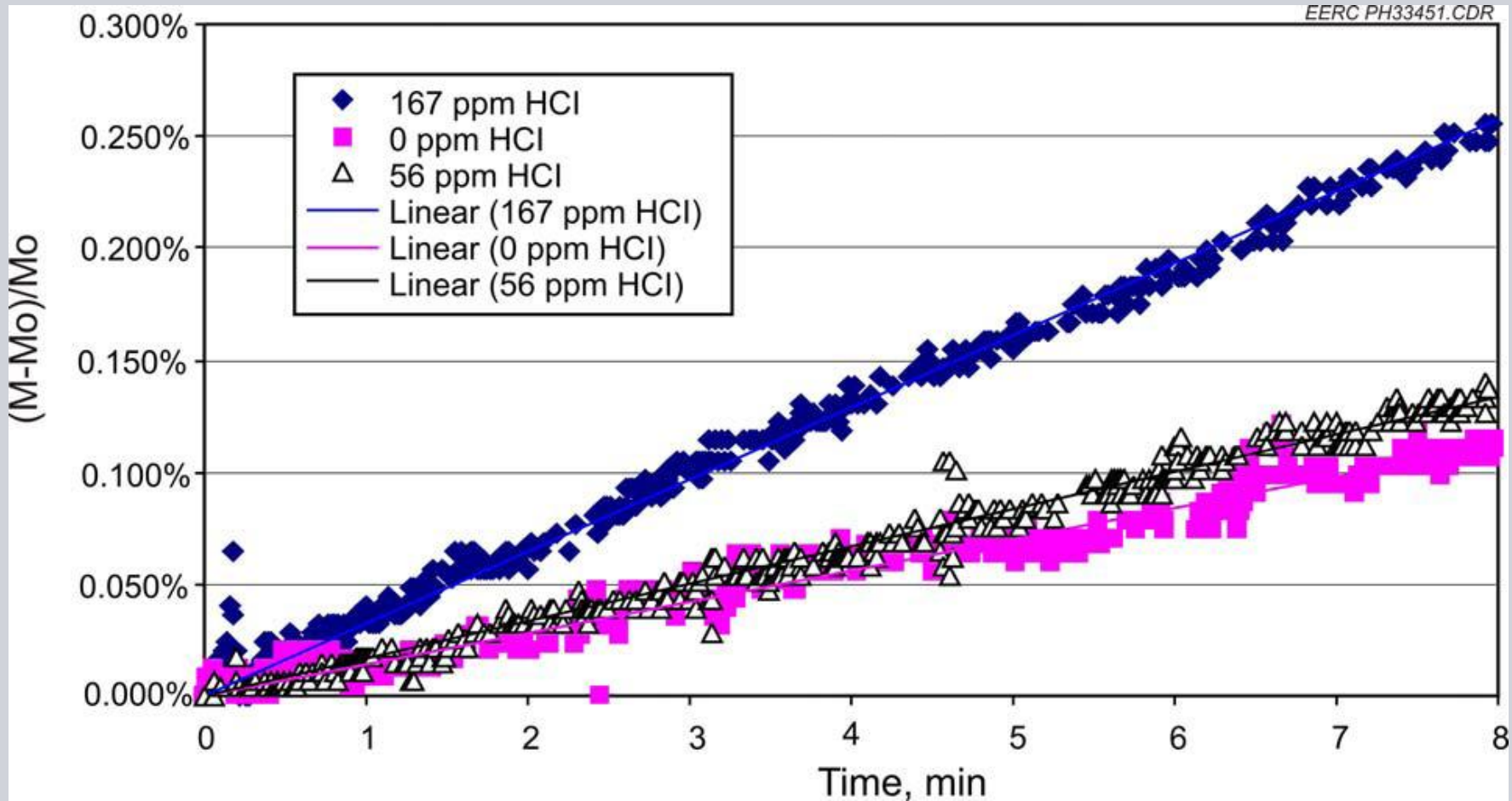


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Effect of SO<sub>3</sub> concentration on adsorption. Reaction conditions: 15% CO<sub>2</sub>, 3% O<sub>2</sub>, 1% HR, 182°C, balance N<sub>2</sub>.

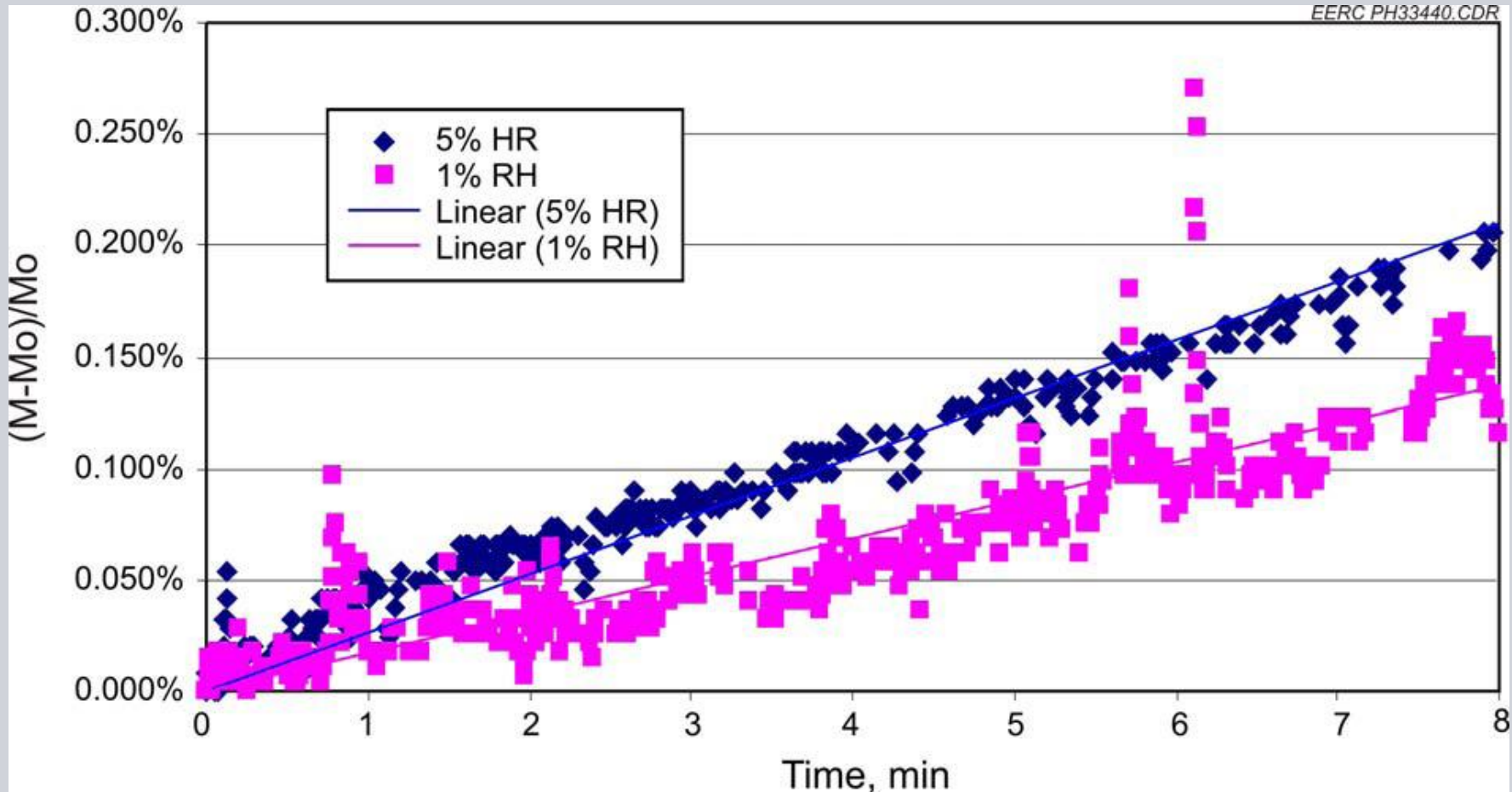
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Effect of HCl concentration on adsorption. Reaction conditions:  
15% CO<sub>2</sub>, 3% O<sub>2</sub>, 1% HR, 182°C, balance N<sub>2</sub>.



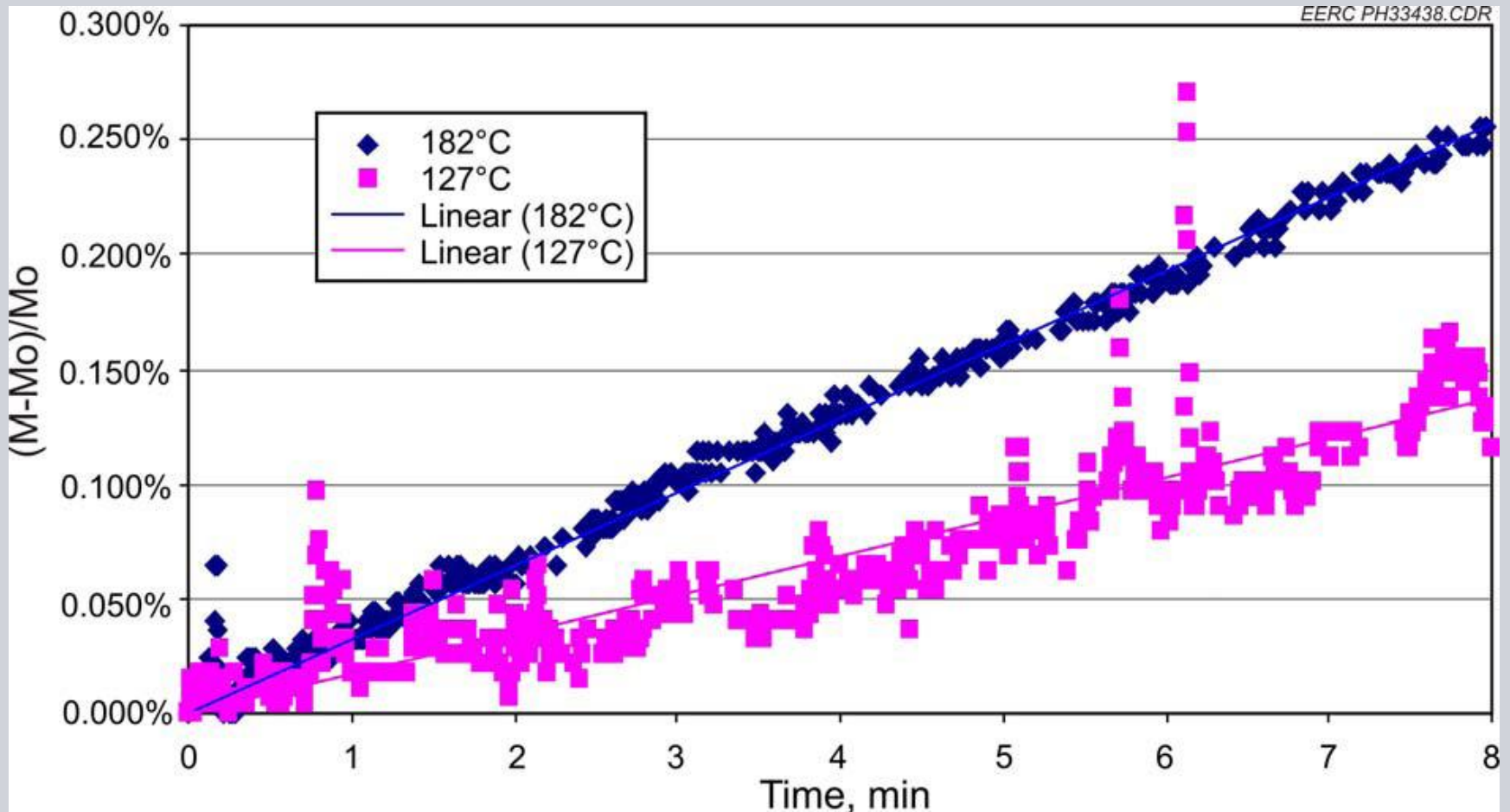
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Effect of *HR* on HCl adsorption. Reaction conditions: 15% CO<sub>2</sub>, 3% O<sub>2</sub>, 167 ppm HCl, 127°C, balance N<sub>2</sub>.

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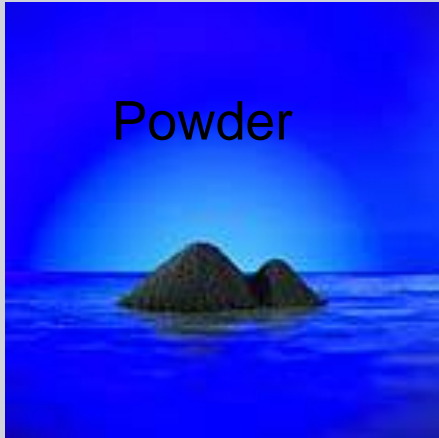


EERC PH33438.CDR

Effect of temperature on HCl adsorption. Reaction conditions: 15% CO<sub>2</sub>, 3% O<sub>2</sub>, 1% HR, 167 ppm HCl, balance N<sub>2</sub>.

## Activated Carbon Injection

Powder



Granular



## Activated Carbon

Pellet



## Activated Carbon Injection

- Activated Carbon – highly porous material produced from coal, coconut, wood or other carbonaceous starting material.
- Most applications involve removal of organics from air and water. It is also used in process applications to purify products and as a catalyst or catalyst support.
- Generally activated carbon can adsorb molecules which are polarizable. The physical process of adsorption occurs because of Van der Waals forces between the carbon surface and the adsorbate molecule. Intermolecular forces result in the molecules condensing into the pores of the carbon.
- Example: carbon exposed to 1ppm of Toluene in water will load up to 9% by weight. 20,000 lb adsorber will hold 1,800 lbs of Toluene – purify 200,000 gallons of water.

## Activated Carbon Injection

How does activated carbon remove Mercury (Hg) from Flue Gas?

- Not “pure” adsorption - there is chemical interaction (sharing of electrons between the carbon surface and Hg).
- Oxidized form of Hg is needed for reaction on the carbon surface.
- The chemical interaction is enhanced or catalyzed by the presence of Chlorine in the flue gas. This promotes the oxidation of the Hg which can then react on the surface of the carbon.

## Activated Carbon Injection

Additional Factors in ACI performance for Mercury control:

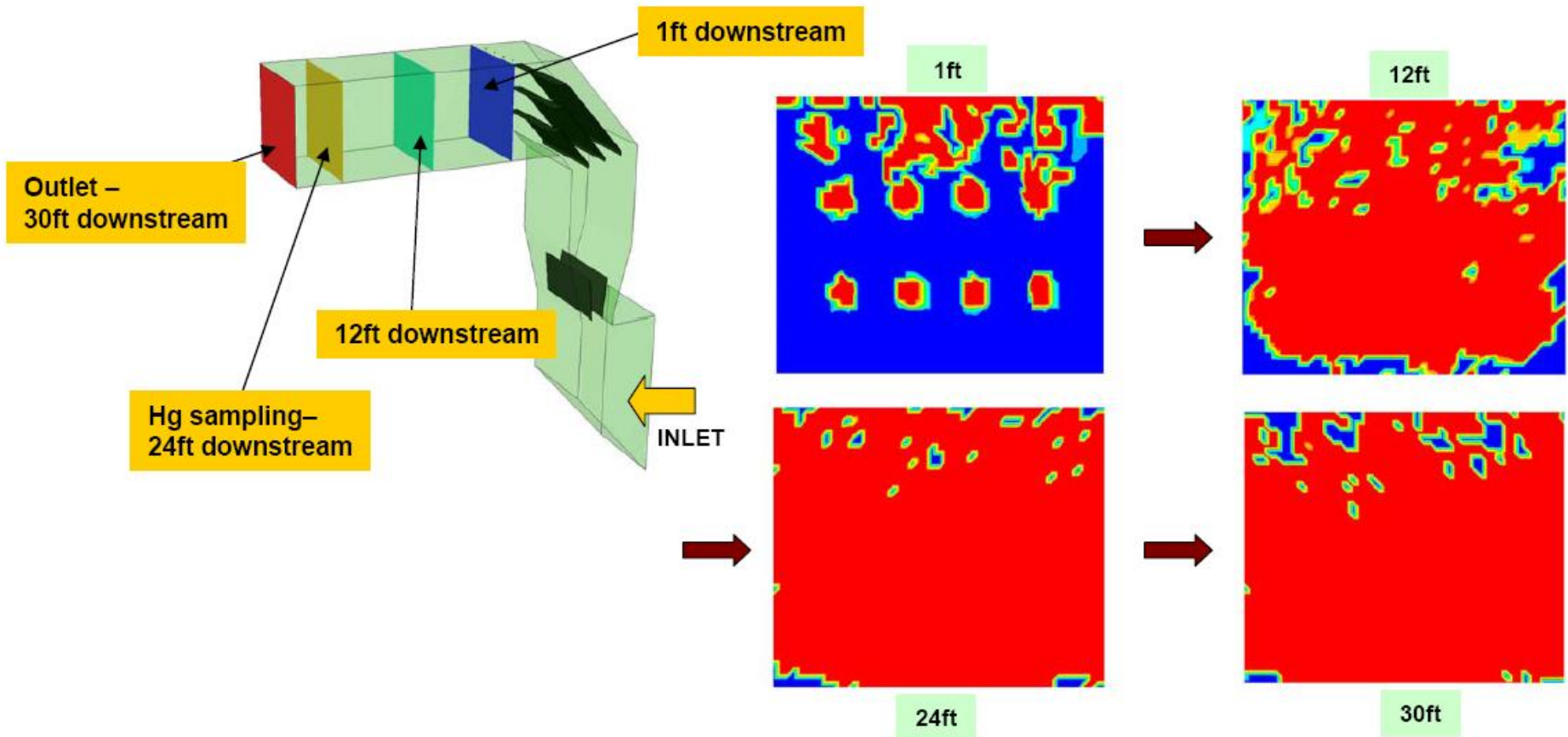
- SO<sub>3</sub> appears to compete for the same sites on the carbon surface as the Hg and thus inhibits or reduces the ability of the activated carbon to remove Hg.
- The powdered form of activated carbon (PAC) is used to maximize the contact between the carbon surface and the Hg.
- For coals with low Chlorine content use of Bromine impregnated PAC to promote the Hg oxidation improves performance.
- Temperature effect – Higher temperature reduces removal.

## Injection Systems

### System Design

- Move up stream to improve distribution / residence time
- Care in design of pneumatic pipe
  - Proper distribution
  - Velocities to prevent build up
- Locate silos close to the injection location
- Weigh feeders vs. volumetric
- Additional in line milling
- On line spares for reliability

## Injection Systems





## Injection Systems



## Sorbent Storage & Metering

## Injection Systems





## Injection Systems

### Mercury Control - PAC Injection Distributors and Nozzle Ports



## Injection Systems





## Injection Systems



## Injection Systems

- ESP & FF considerations
  - Fly ash sale
  - FF – air/cloth ratio
  - PAC smoldering
  - FF cleaning cycle can affect performance
  - Ash system plugging

Questions?

Thank You



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