

Worldwide Pollution Control Association

WPCA-
Southern Company
Mercury Seminar
October 30-31, 2012

All presentations posted on this website are copyrighted by the Worldwide Pollution Control Association (WPCA). Any unauthorized downloading, attempts to modify or to incorporate into other presentations, link to other websites, or to obtain copies for any other purposes than the training of attendees to WPCA Conferences is expressly prohibited, unless approved in writing by the WPCA or the original presenter. The WPCA does not assume any liability for the accuracy or contents of any materials contained in this library which were presented and/or created by persons who were not employees of the WPCA.



Visit our website at www.wpca.info





Impact of DSI on Mercury Removal

Presented by: Cal Lockert/Breen Energy

Presented to: WPCA Hg Conference

October 30, 2012



Key Points to Consider



- 1. Relationship between ACI effectiveness and the presence of sulfuric acid vapor**
- 2. DSI effectiveness on Sulfuric acid vapor removal**
- 3. Acid Gas & DSI Stratification Issues as they relate to ACI effectiveness**
- 4. Secondary Acid Gas Removal Effects: the good with the bad**

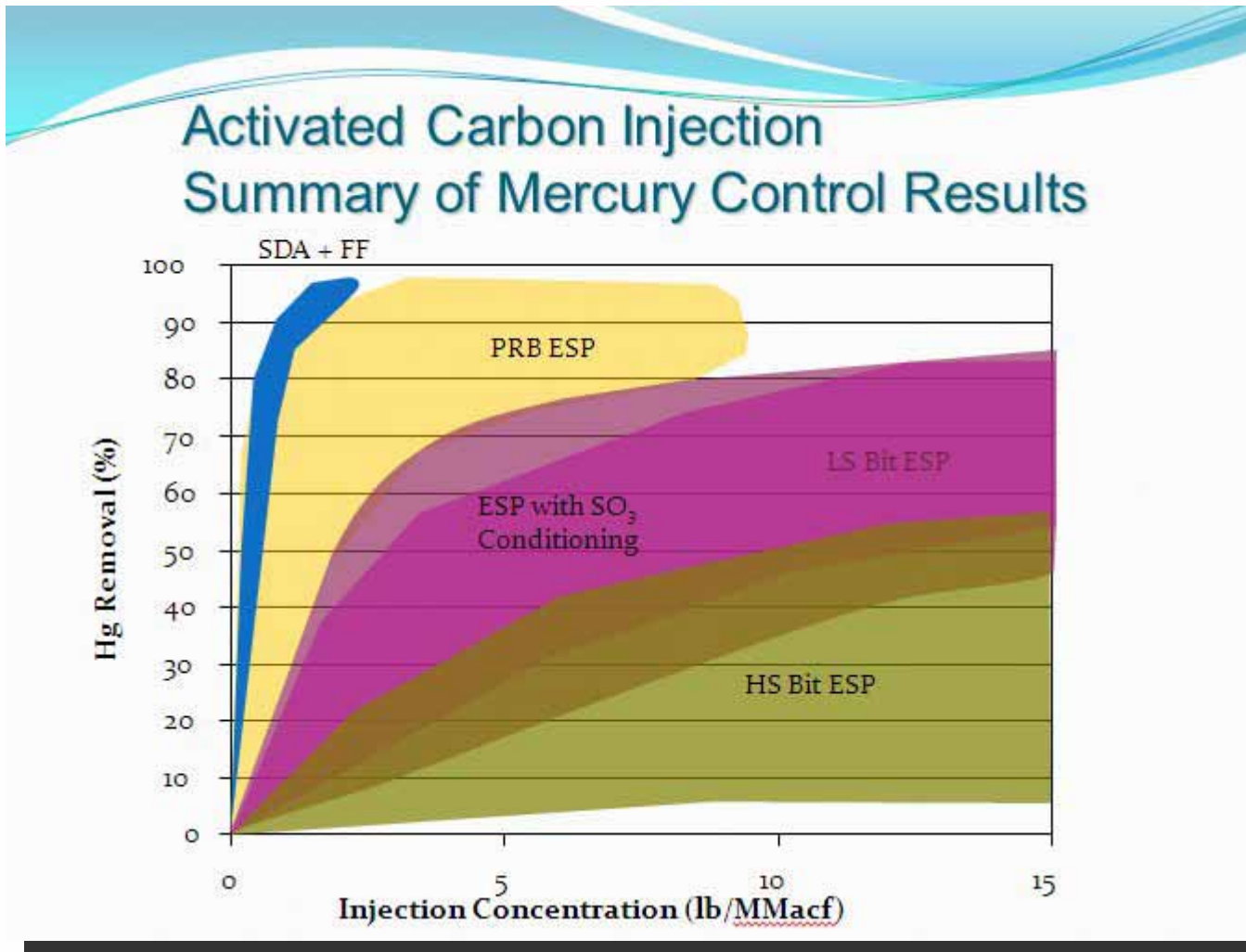


The role of SO_3 in the process

Some want it and some don't




A summary of Hg/ACI Control



Slide courtesy of ADA-ES




Too Much SO₃ for the ACI



Examples of Full-Scale Hg Control Results at Bituminous Plants with SO₃

- AEP Conesville Unit 6 (CV6), PC boiler, no SCR
 - 3.5% to 4% sulfur coal. SO₃ ~ 20 to 30 ppm
 - No native removal across ESP
 - Mercury removal across ESP limited to 30% at ACI up to 20 lb/MMacf
- PSNH Merrimack
 - Low sulfur bituminous coal, cyclone boiler, high conversion SCR (> 10 ppm SO₃)
 - SO₃ > 10 ppm
 - No native mercury removal coal to stack
 - Maximum 20% mercury removal up to 10 lb/MMacf PAC
 - SO₃ > 5 ppm (6 – 7 ppm)
 - Hg removal 50% at 4.5 lb/MMacf PAC
 - SO₃ < 5 ppm (3 – 4 ppm),
 - Hg removal 70 – 75 % at 4.5 lb/MMacf, 80% at 6 lb/MMacf

© 2011 ADA-ES, Inc. Proprietary and Confidential Information All Rights Reserved



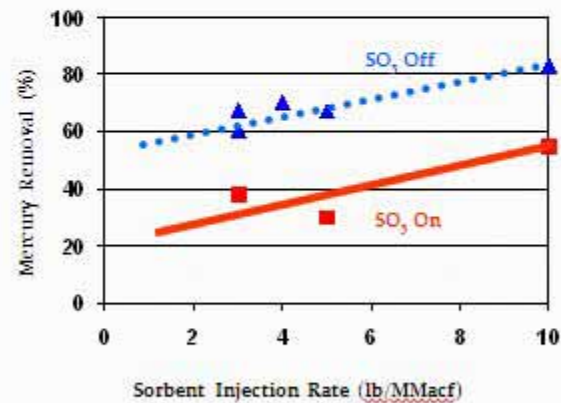
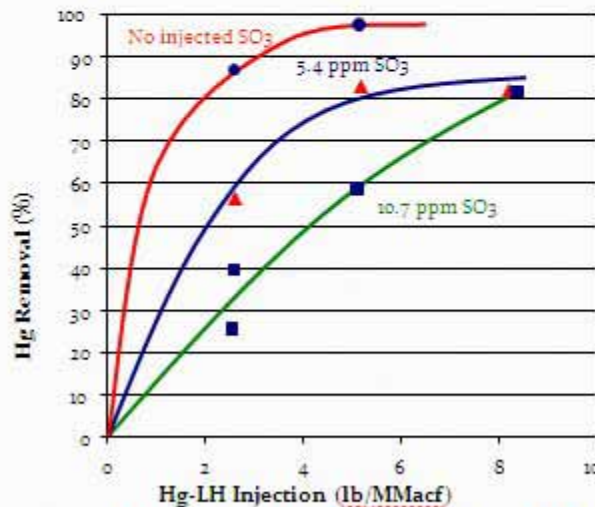
Slide courtesy of ADA-ES



Too Little SO₃ for the ESP

SO₃ Injection and PAC Effectiveness

- SO₃ is used to condition fly ash for better capture in ESPs
- Typical injection targets < 10ppm in gas phase
- Any SO₃ in gas phase appears to affect Hg capture

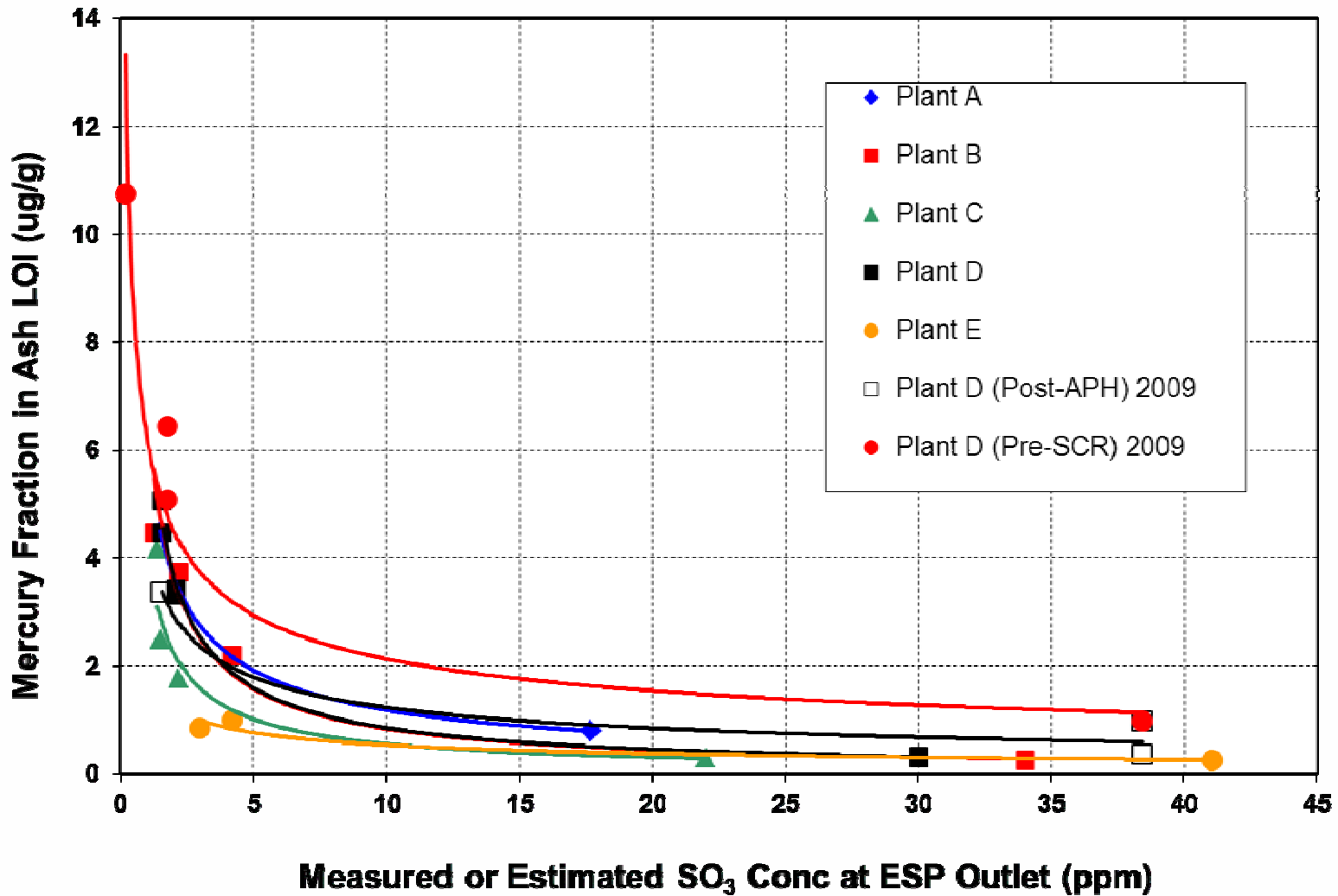


Ameren Labadie Data: DOE DE-FC26-03NT41986 and EPRI PRB, ESP

Mississippi Power Plant Daniel
Low sulfur bituminous coal

Slide courtesy of ADA-ES

SO₃ vs Native Carbon



Slide courtesy of URS



Summary of SO₃:Hg Interaction



- **Much has been observed and reported on the interplay between Sulfuric Acid Vapor, Activated Carbon Injection, Mercury Capture and ESP performance**
- **What is fairly clear, from all of the research, is that increasing levels of H₂SO₄ have a negative, and costly, effect on the performance of the Mercury Capture process**
- **General rules of thumb suggest that maintenance of “SO₃” levels below 5 ppm ahead of the ACI injection point can cut carbon costs in half**



DSI Effectiveness in Acid Gas Control



This is essentially an entire workshop in itself

Basically:

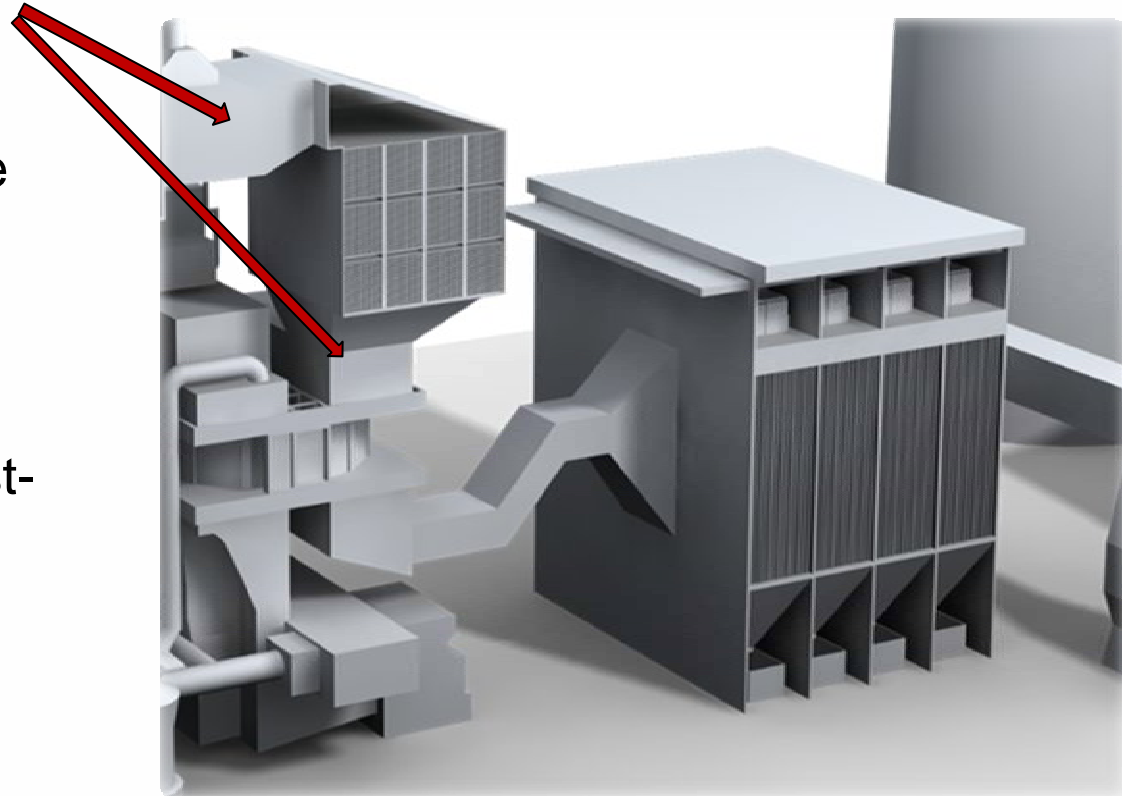
- Both Calcium and Sodium sorbents have been successfully applied to this application.
- There are pros and cons to both sorbents, depending on the plant specific needs
- As with ACI, distribution and residence time are critical
- A residence time of 1 second is generally desired to achieve desired acid gas removal for the purpose of Hg Capture enhancement.

So, given 10 minutes or so, what new information is worth covering:



Pre-AH Mitigation of Acid Gas:

- Improves residence time and acid gas capture
- Lowers the threat of AH fouling
- Is less efficient than Post-AH Injection
- May have downstream distribution impact



Currently more than 20 units are injecting sorbent at a location ahead of the AH for acid gas control (both Lime and Sodium)

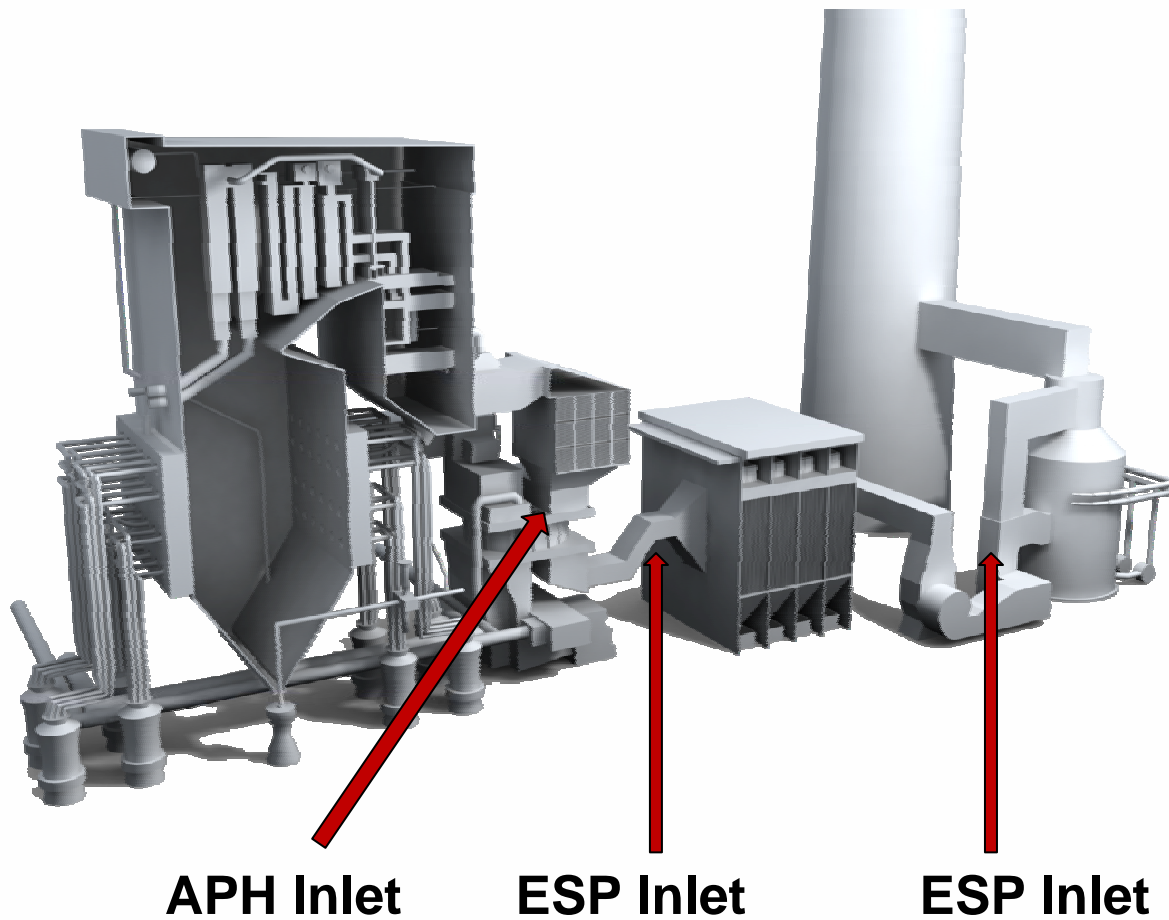


Stratification Impacts

A Real World Study



One Plant's experience



Sorbent Injection Points

SO₃ Objective:

.009 #/mmBTU

**Plant often
experienced Stack
SO₃ higher than FGD
Inlet SO₃ without
excessively high
Sorbent NSRs**



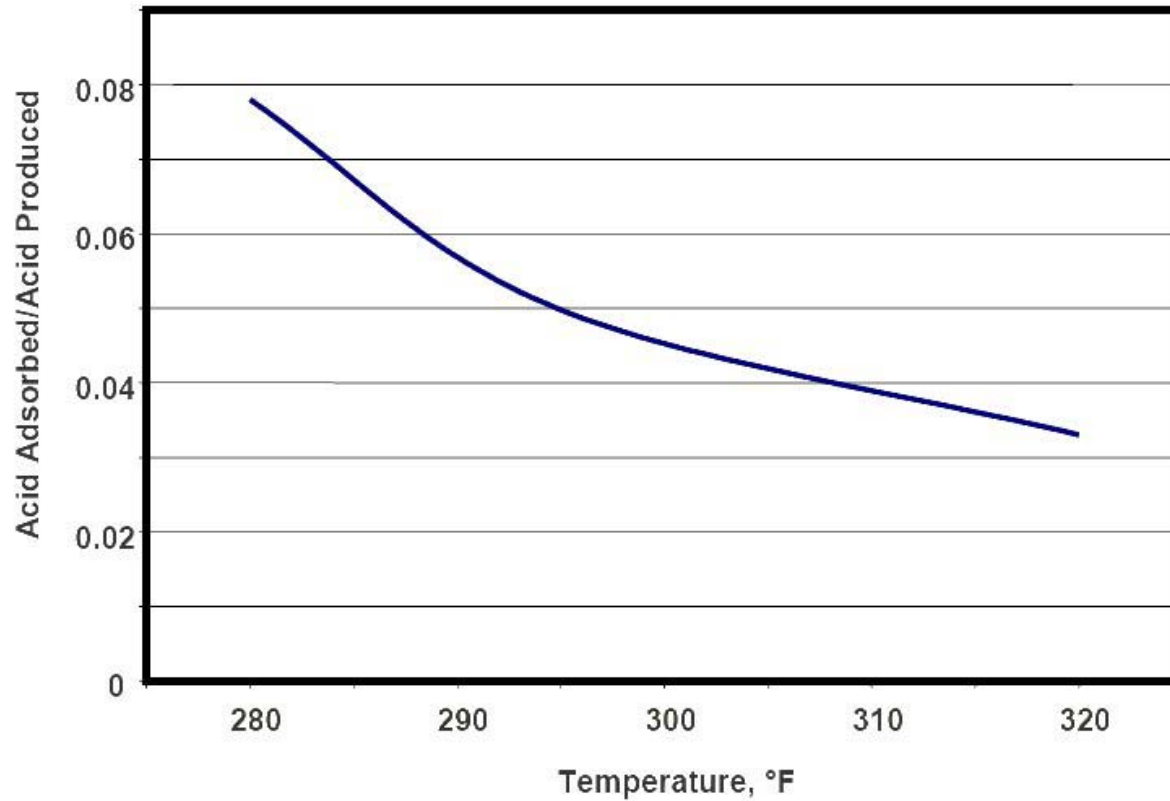
Horizontal Stratification



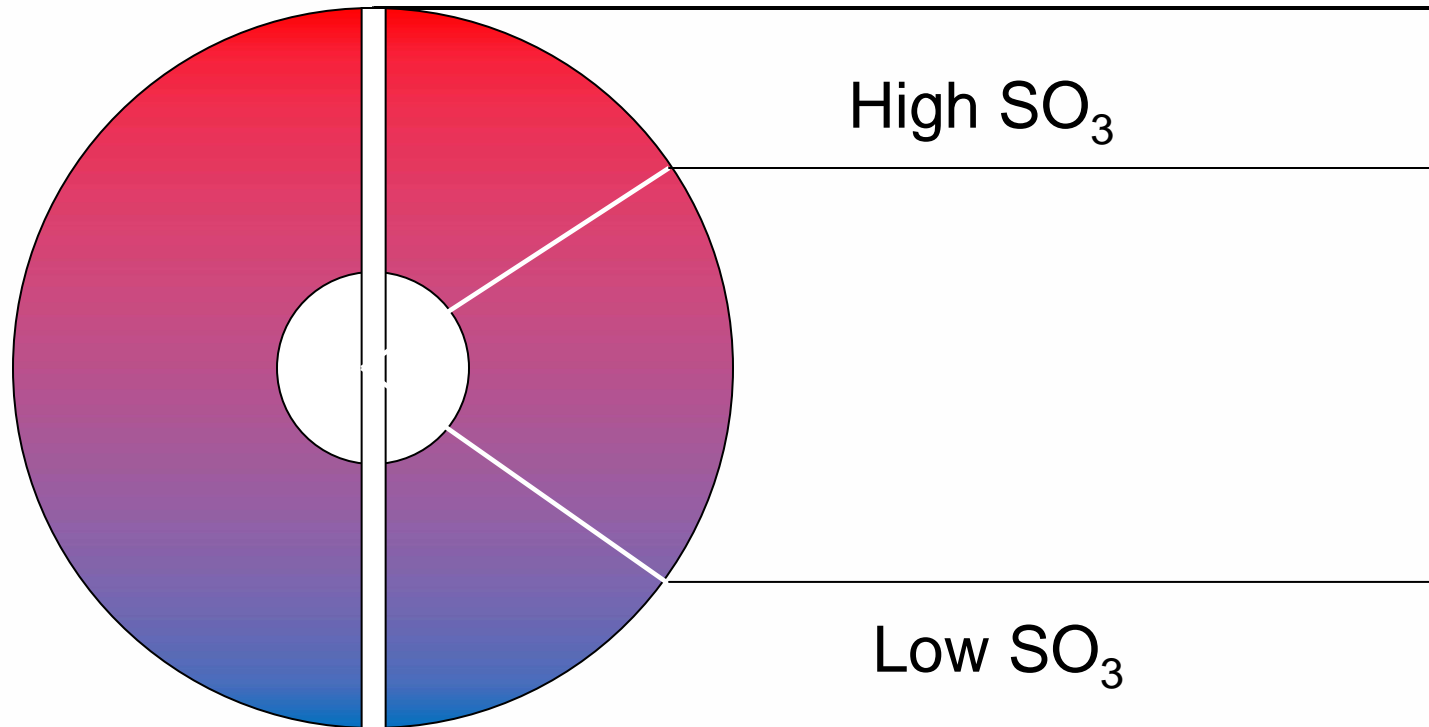
Acid Adsorption onto Flyash



Acid Adsorption on Fly Ash



Air Heater Concentration



- **The air heater is well known as a magnificent acid concentrator.**
- **However, acid concentrations follow the acid vaporization temperature that may, or may not, be at the far, hot, side of the duct.**
- **At this plant, horizontal traverses were conducted at the FGD Inlet location and no dramatic stratification was found (although the number of available ports was limited).**



Vertical Stratification?

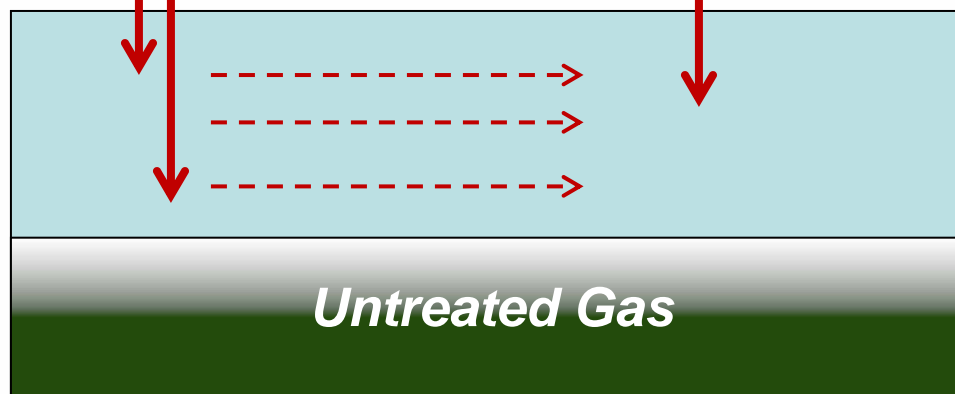


Vertical Stratification Theory

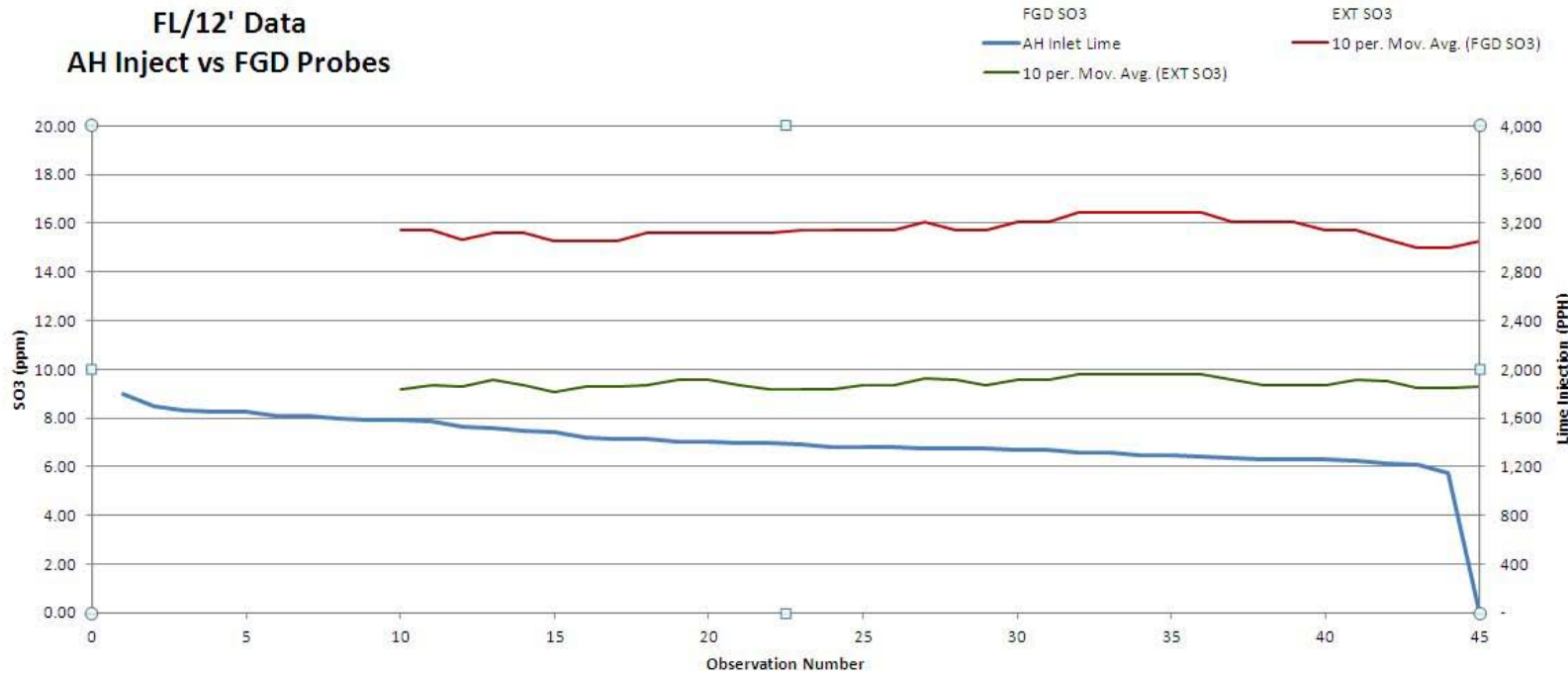


Sorbent Injection

M8A Test



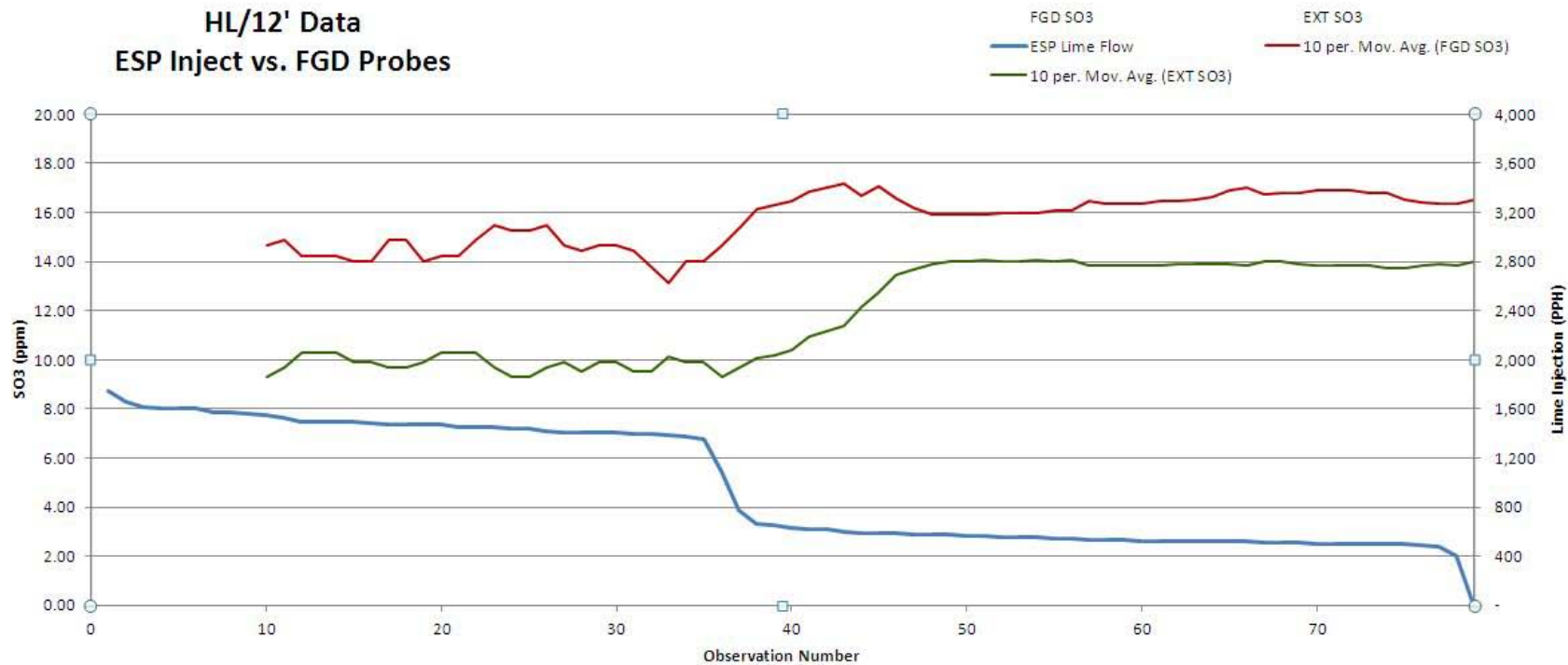
AH Inlet Injection Only



- Acid levels are higher at the top of the duct,
- Not enough data to project treatment sensitivity



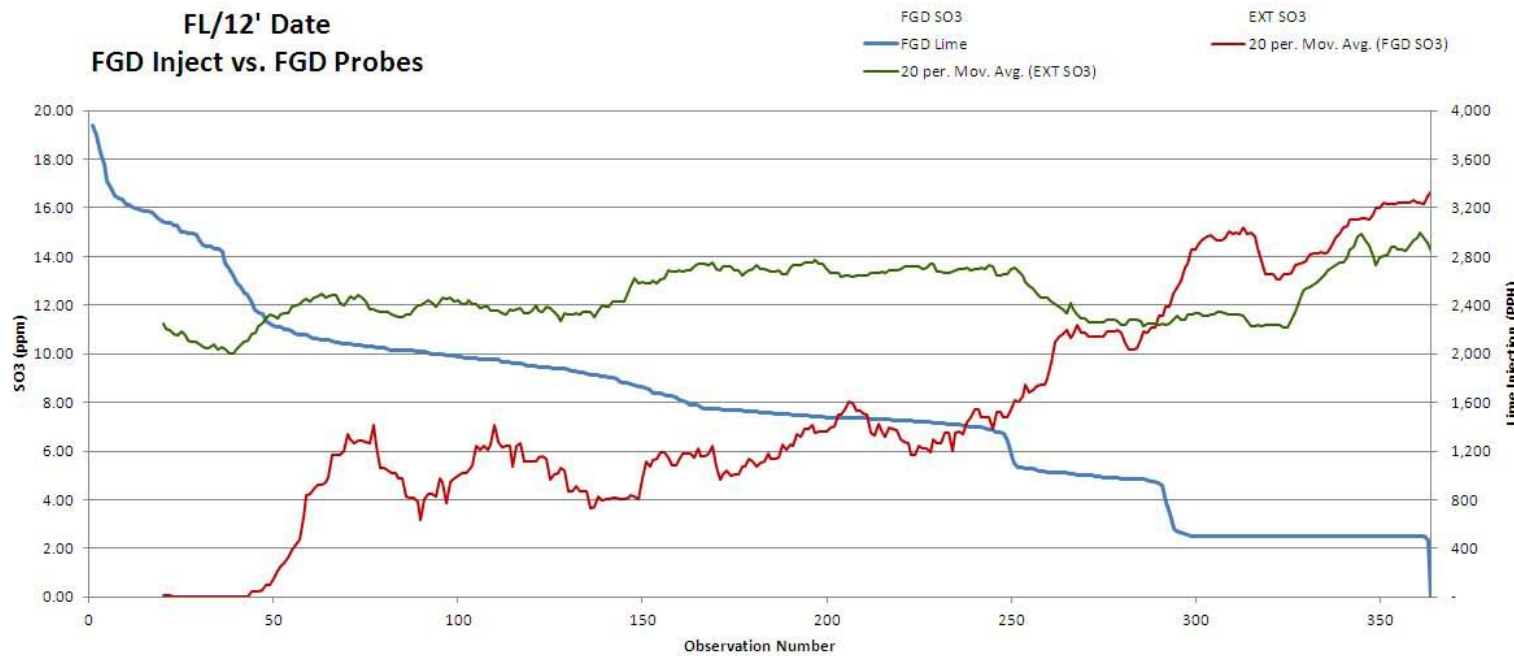
ESP Inlet Injection Only



- Acid levels are higher at the top of the duct,
- Material at bottom of duct seems more sensitive to sorbent



FGD Inlet Injection Only



- Top of duct acid levels are highly influenced by FGD Injection
- Bottom of duct acid seems only mildly sensitive
- This represents a clear indication of sorbent stratification at this location



- **Clearly this discussion was focused on sulfuric acid distribution.**
- **But the impact of high sulfur levels of carbon capture of Hg is well documented.**
- **So, high levels of acid stratification are linked to less than optimum utilization of ACl for Hg capture.**



HCl – The Other Acid Gas

Whether Intentional or due to SO₂ Scrubbing



SO₃ or HCl – What Goes First? Baghouse Removal Data



- Midwestern Utility; med-high sulfur coal
- Hydrate injection post APH using temporary injection system
- Test runs measured at baghouse outlet
 - Controlled condensate (SO₃) and 26A (HCl)

	Content, ppm		Reduction	
	SO ₃	HCl	SO ₃	HCl
<i>baseline inlet</i>	25	24	---	---
<i>baghouse outlet</i>	16	22.5	36%	<10%
lb Ca:lb SO₃				
2.15	4.9	21.9	80%	<10%
2.70	1.4	24.7	94%	<10%
3.24	<1	<1	98%	>98%

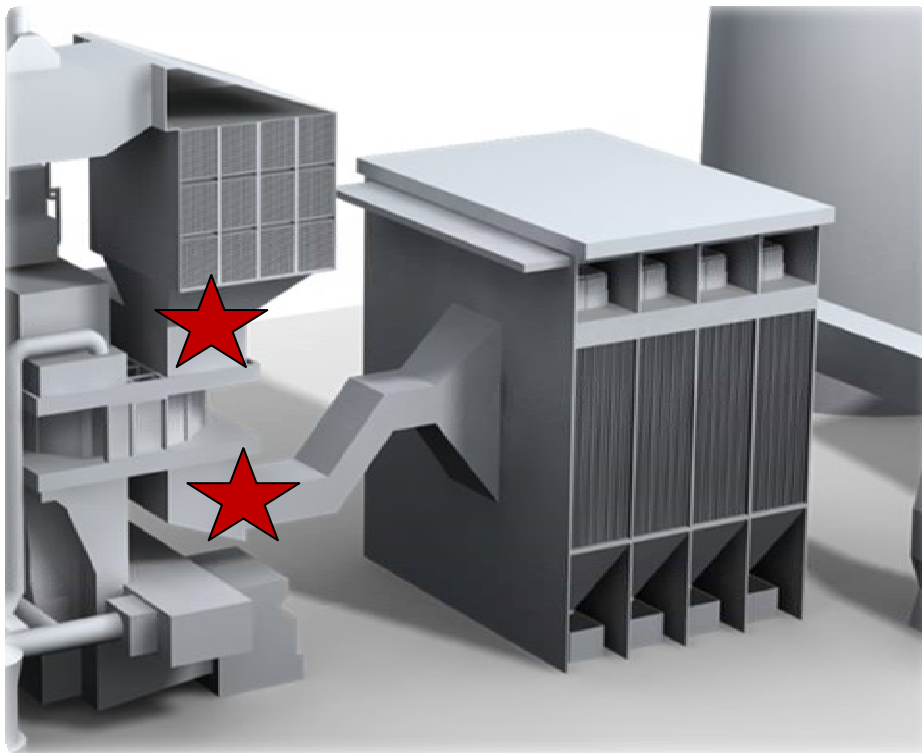
Reduced sorbent usages vs. ESP

Low emission capability

13

Slide courtesy of Mississippi Lime

Focused HCl Capture

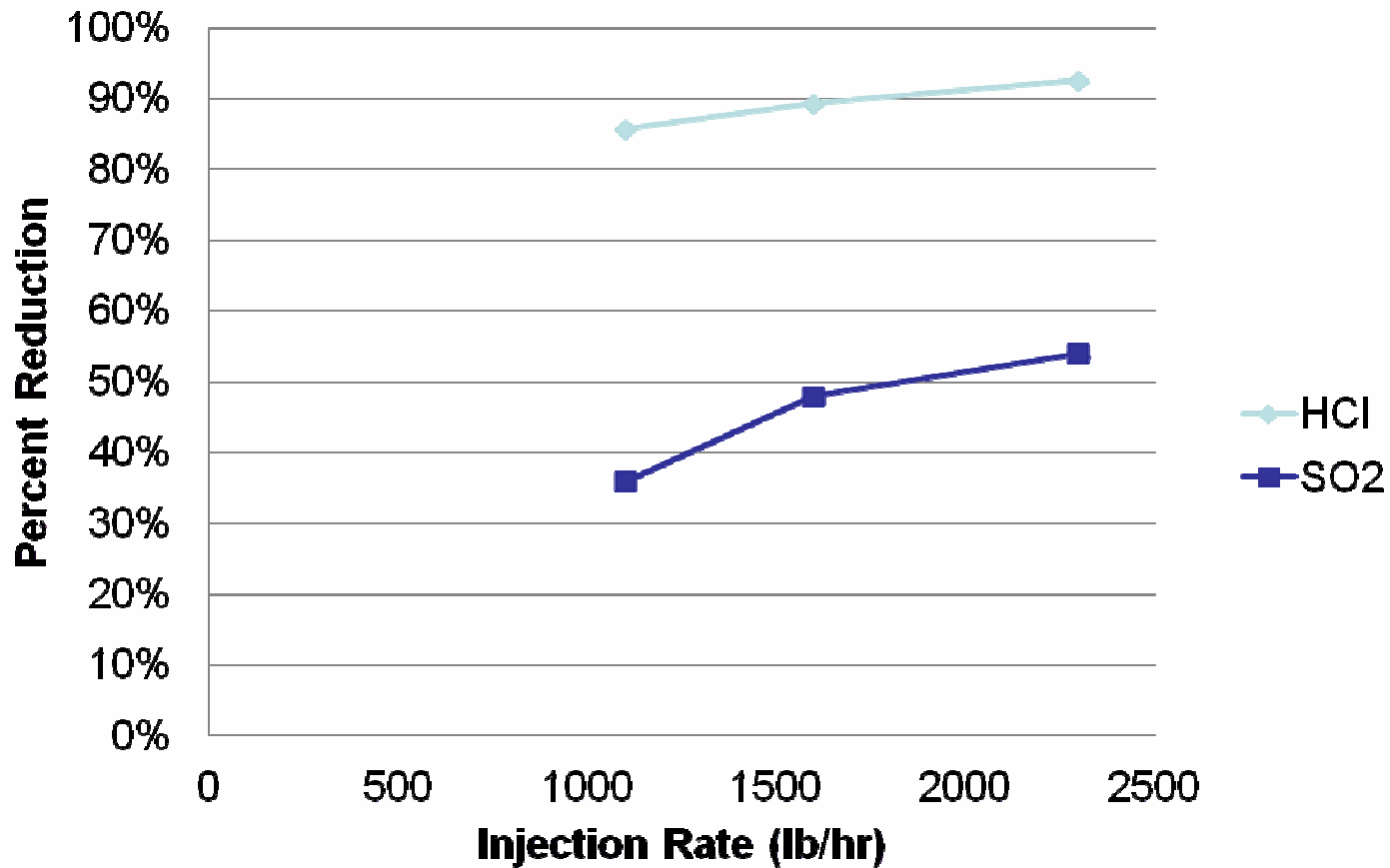


Significant effort is being spent by many utilities to enhance capture of HCl prior to particulate capture. This provides significant improvement in FGD water chlorides

Additionally, significant work is focused on sodium sorbent injection for SO₂ control.



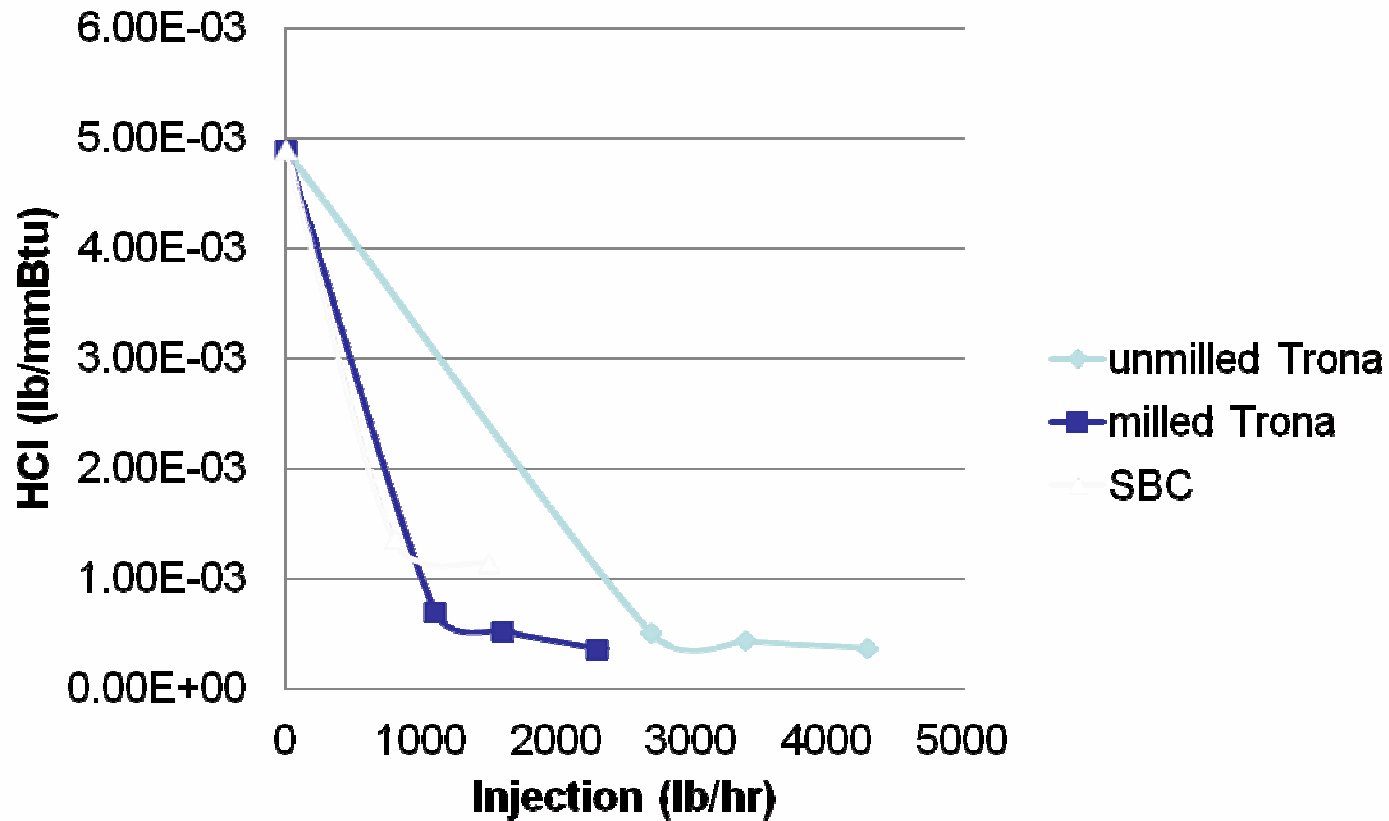
Milled Trona SO₂/HCl Reduction



Slide courtesy of NatronX



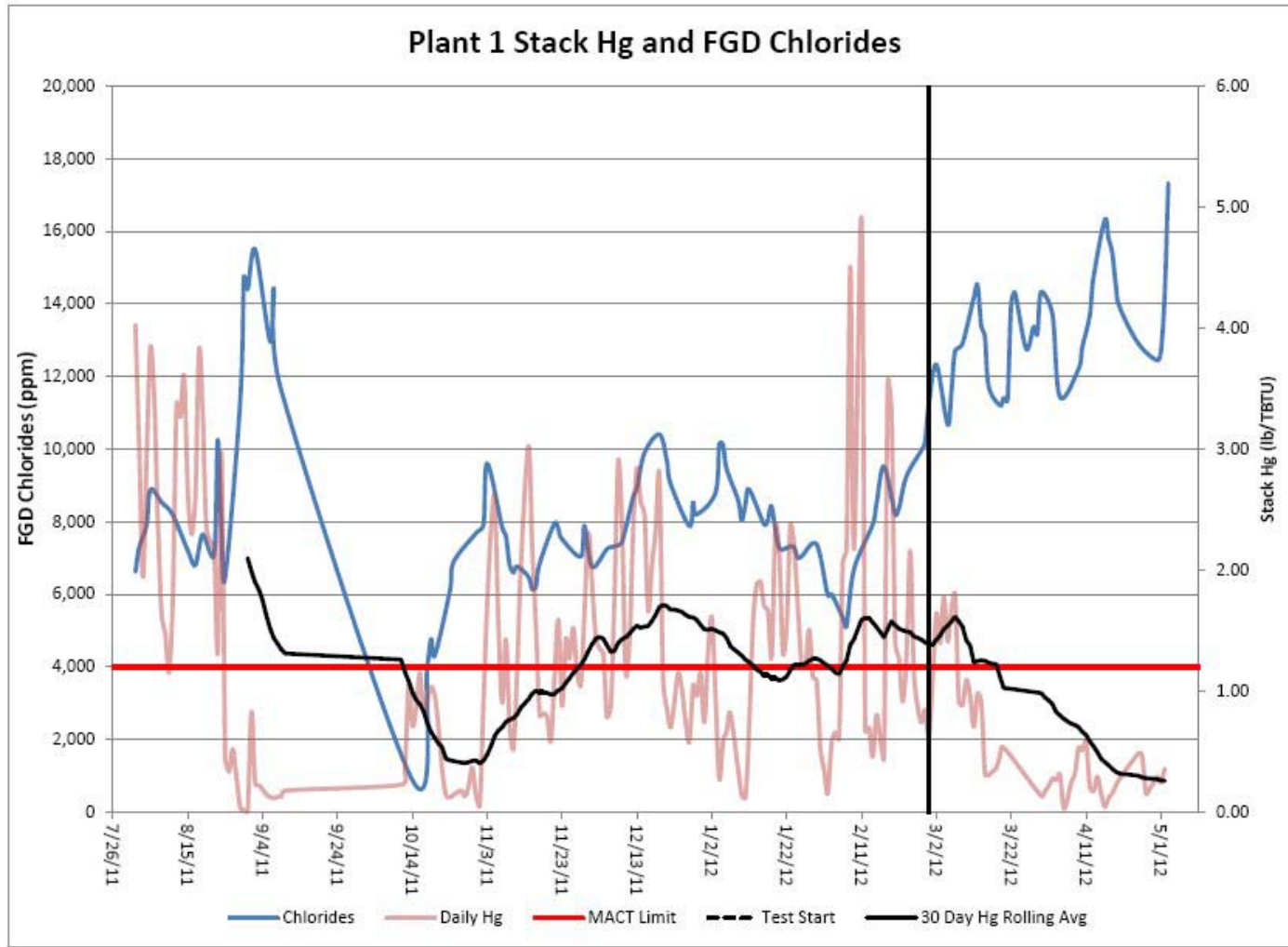
HCl Reduction with Trona/SBC



Slide courtesy of NatronX



Re-emission?



HCl – Friend or Foe?



- **A great deal of work is being done to optimize capture of HCl in dry flight.**
- **Removal of Chlorides from the scrubber water has a significant commercial impact on the water treatment cost of the plant.**
- **However, this data suggests that re-emissions of Hg are minimized in direct relation to the level of chlorides in the scrubber water.**



Conclusions



Some Expected Take-aways



- 1. There can be no doubt that DSI for mitigation of acid vapor dramatically improves both the technical and commercial aspects of Hg emissions compliance.**
- 2. Maintenance of an acid vapor concentration at or near 5 ppm ahead of the ACI injection point is desired**



Some New Take-aways



- 1. DSI, ahead of the Air Heater can have significant positive effects on air heater fouling, ABS minimization and overall SO₃ reduction residence time. This location is no longer new or unproven.**
- 2. Natural gas movement through the Air Heater and the downstream ducts can dramatically skew gas and sorbent distribution. This needs close attention and periodic tuning.**
- 3. DSI secondary capture of HCl may lower corrosion and water treatment costs, but may also increase Hg re-emission in the FGD.**



Thank You

