Worldwide Pollution Control Association

WPCA/LG&E and KU

Coal-fired APC Environmental Seminar

May 23-24, 2017

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Hydrated Lime Panel

Mississippi lime

DISCOVERING WHAT'S POSSIBLE WITH CALCIUM

WPCA/LG&E and KU Seminar

May 23, 2017

MISSISSIPPI LIME

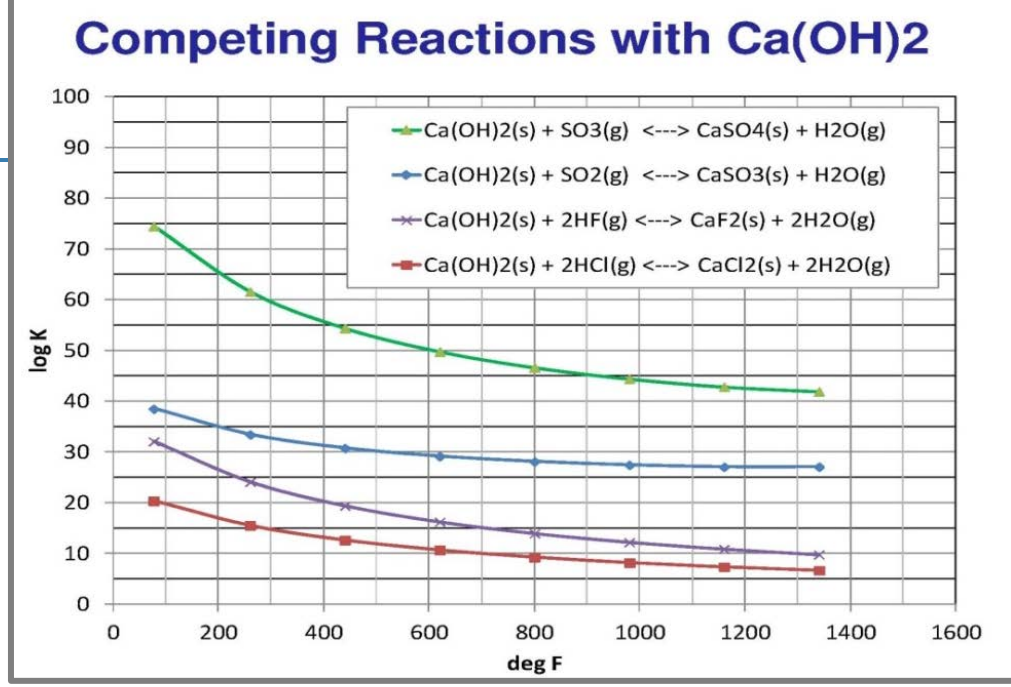
Discovering what's possible with calcium

Hydrate Lime – Expanded Role in DSI

Past	Today	Future
Standard hydrate • Poor utilization	Enhanced hydrates • Good utilization/good performance	Further advancements • “Horses for Courses”
Conveying issues	Best practices understood	Eliminate scale and dry powder plugs
Just get it into the duct	Injection and in-duct options to improve distribution	Understand flue gas and utilize good distribution to gain O&M benefits
Remove pollutant	Keep APH clean while removing pollutant	Reduce Minimum Operating Temperature
Reduce SO_3	Reduce SO_3 and HCl (MATS)	Reduce HCl, Se, etc. and assist wFGD operations

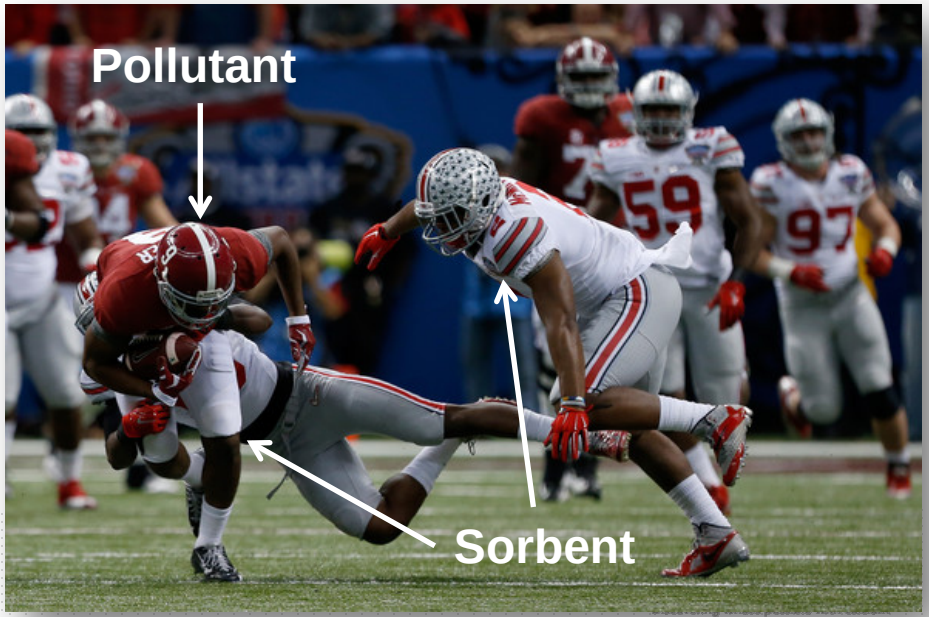
Reactivity & Removal

- Thermodynamic
  - $SO_3 > SO_2 > HF > HCl$

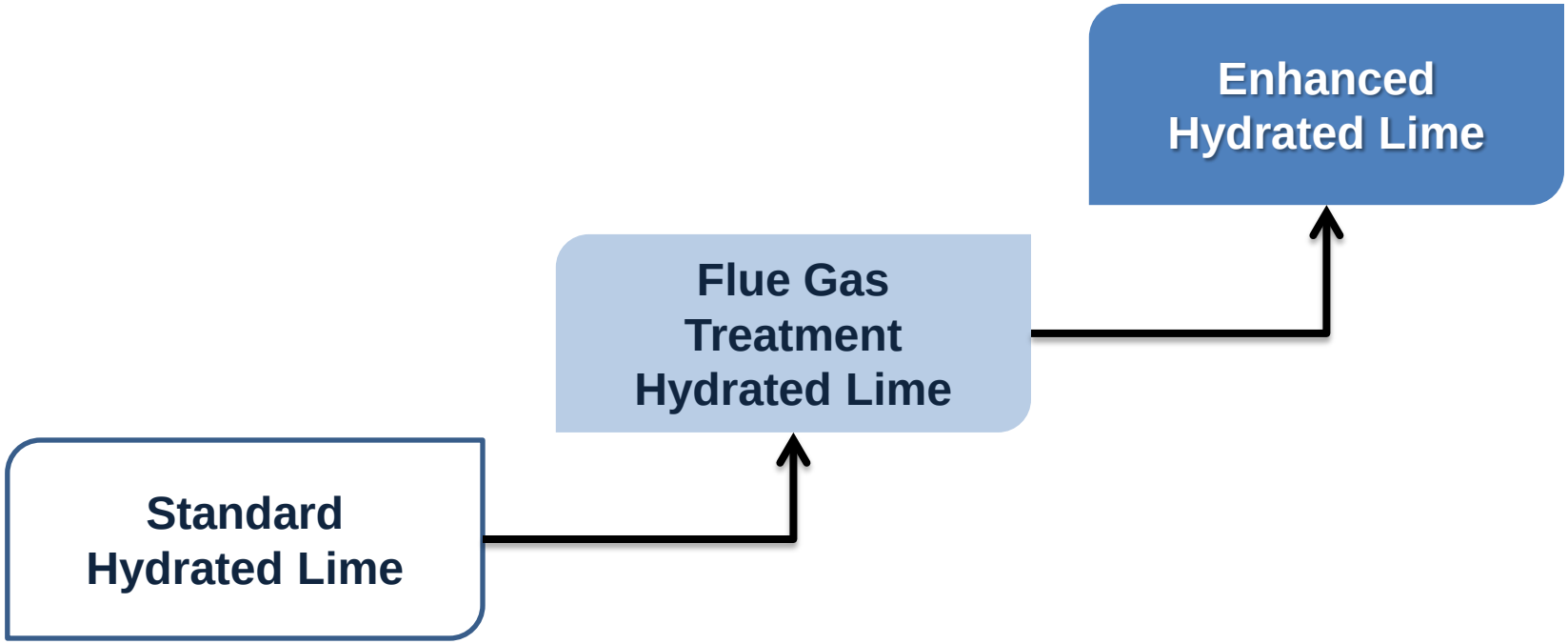


Benson, 2012 DHUG

- Kinetic
  - Maximize collisions
  - Hydrate D_{50} ~ 2-4 μm
  - Gas particles ~ 0.0003 μm



Hydrated Lime Advancements



- Enhanced hydrates: Higher performance and/or lower annual delivered cost savings
- Physical differences between grades and suppliers
  - Bulk density
  - Particle size
  - Flow characteristics

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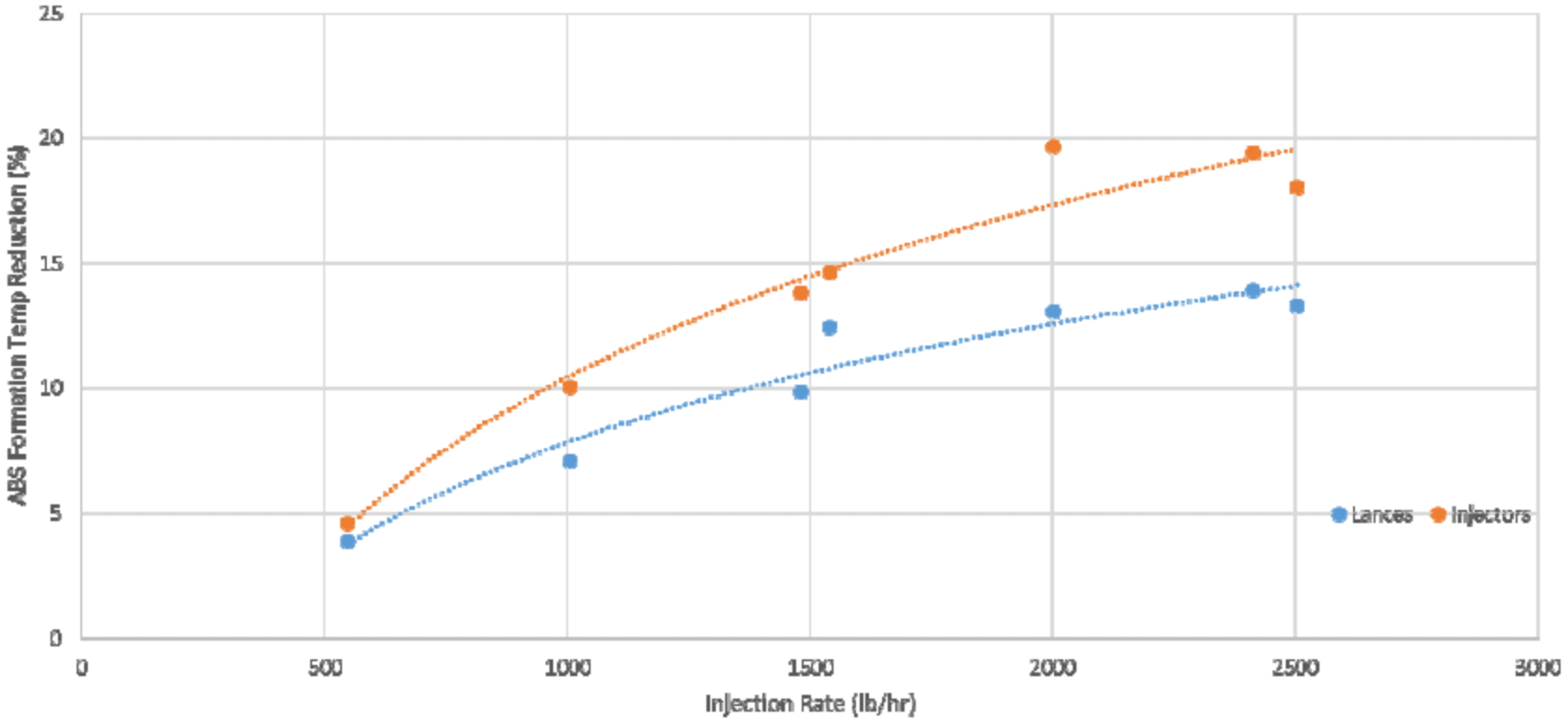
Injection Grid Advancements

Result | ABS Formation Temperature vs HL Injection Rate *(normalized)*



Lund, Nol-tec – 2017 Dry Hydrate Users Group Conference

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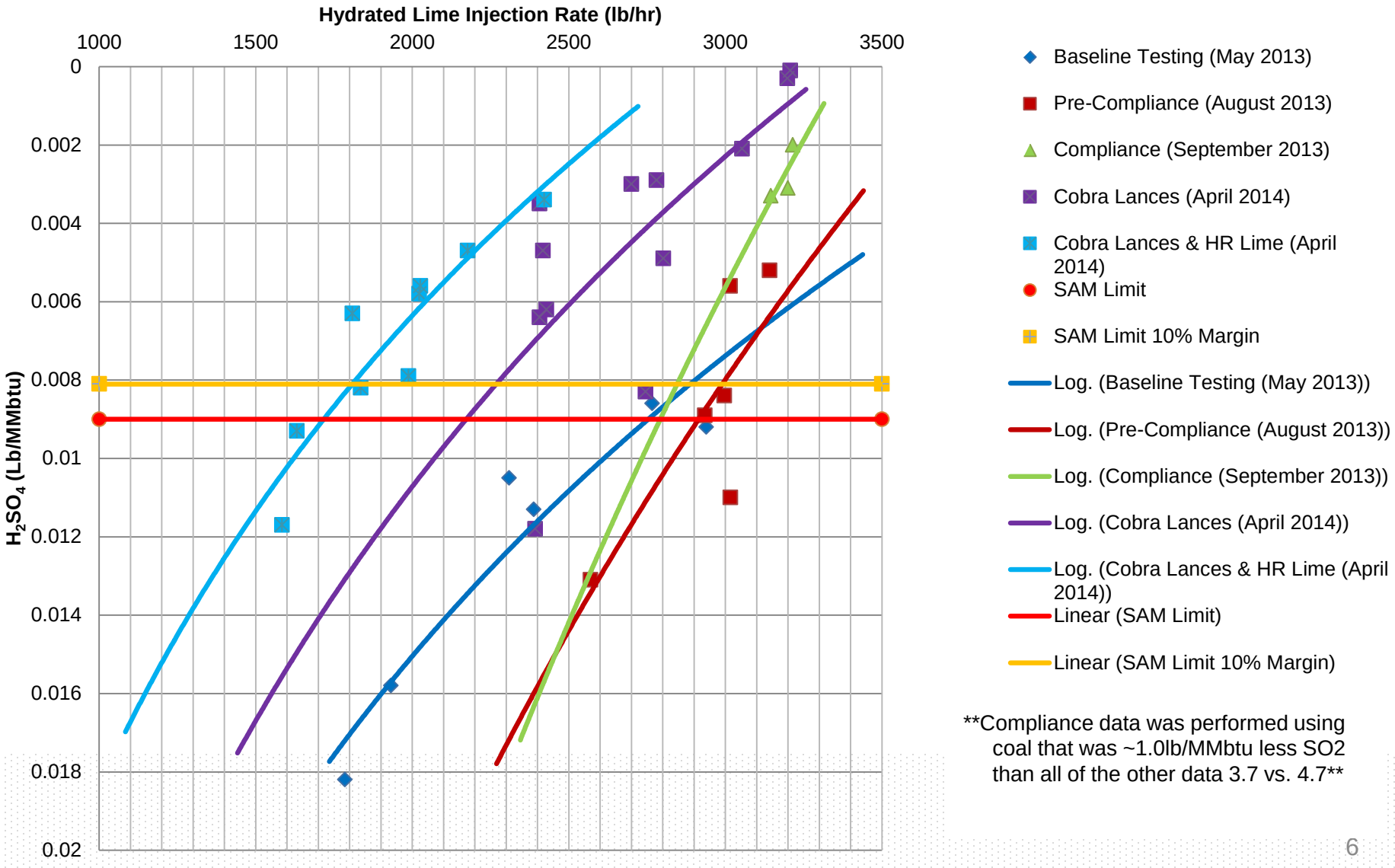
Enhanced Hydrate + Distribution Benefits

Data courtesy of Chad Donner of Duke

Duke DSI Performance Improvements



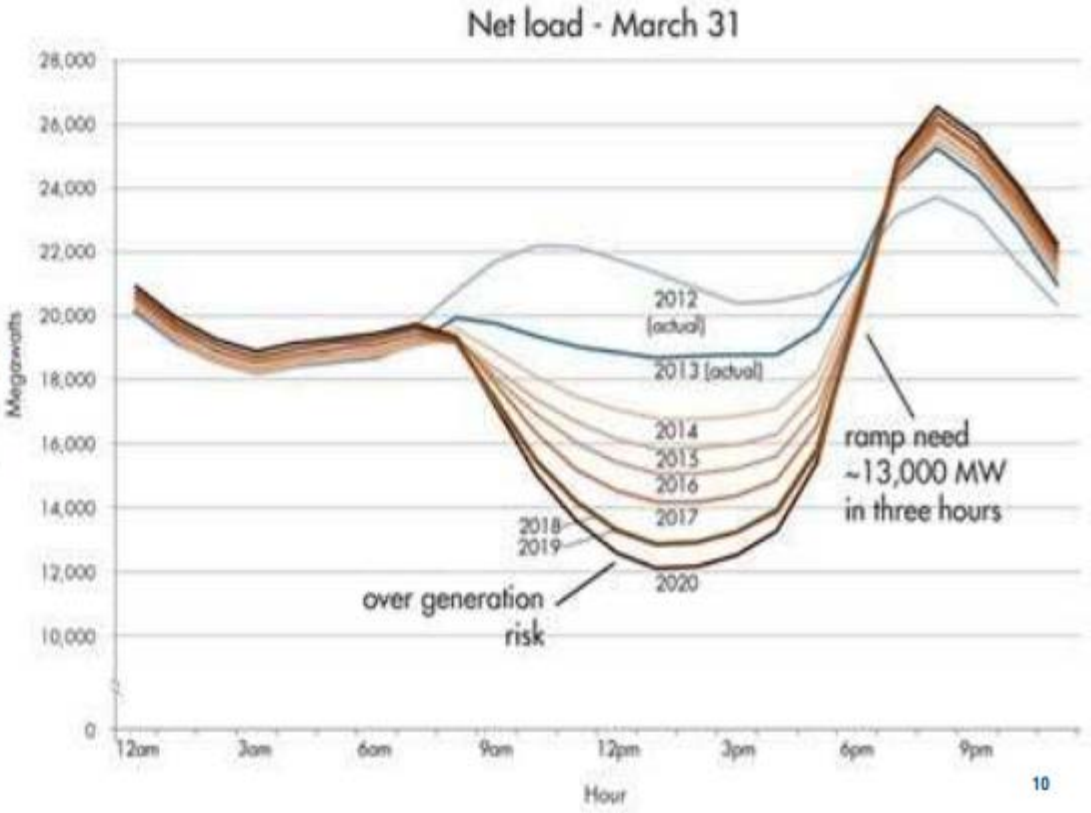
Compliance data was performed using coal that was ~1.0lb/MMbtu less SO2 than all of the other data 3.7 vs. 4.7

Reduce Minimum Operating Temperature

Donner, Duke
2017 Dry Hydrate Users Group Conference

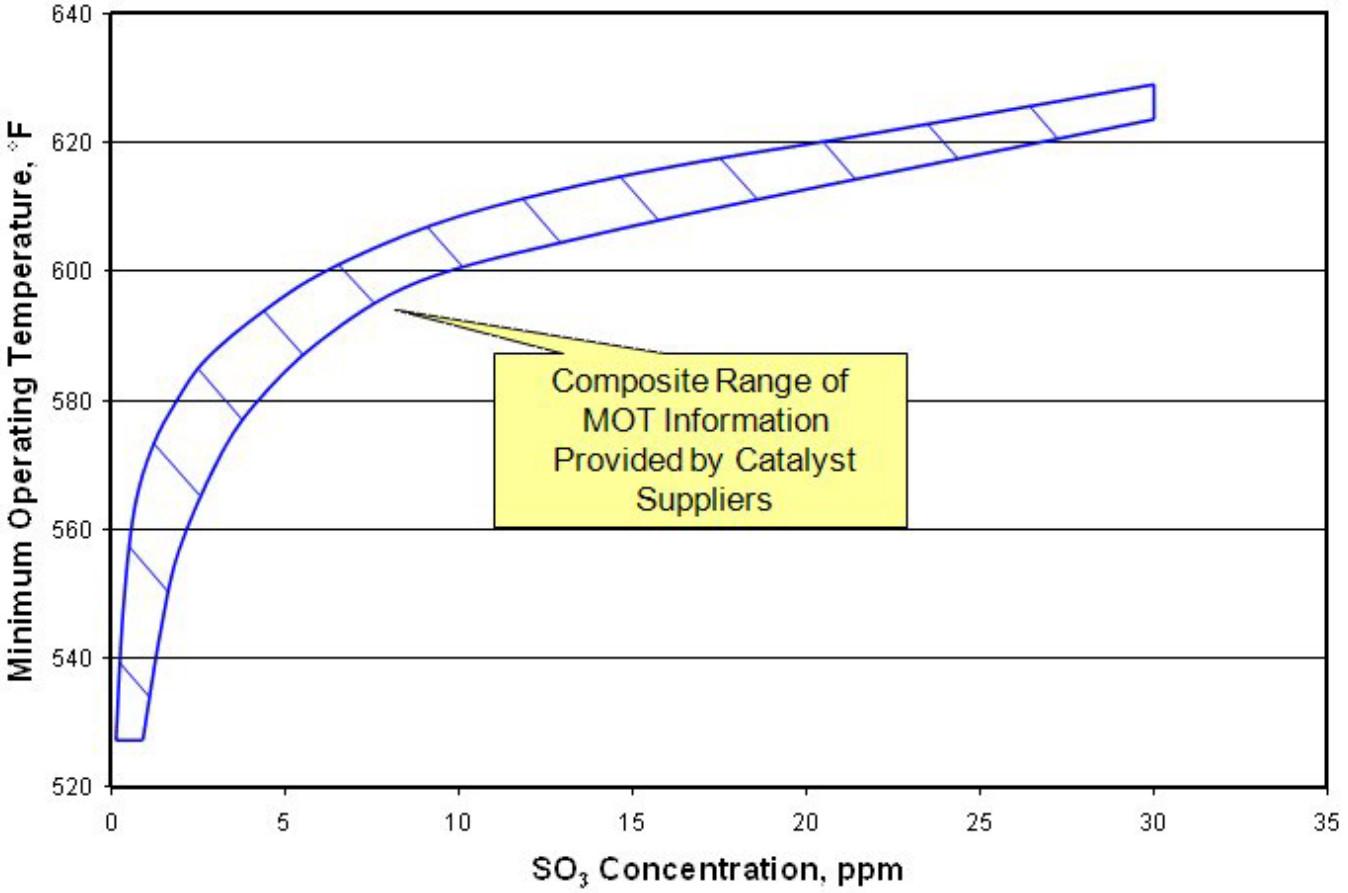
Reduced Catalyst MOT

- Why???
  - Solar and wind have created large amounts of peak generation that are priority
  - Coal must now load follow to a degree and be more nimble for turndown and ramp rate
  - New Ozone season limits will require pushing the SCR's harder and keeping them in service longer



Greater turn down improves dispatch position, capacity factor, and profit

What is MOT?



- Minimum Stable Load often driven by the Minimum Operating Temperature of the SCR.
- The MOT of a SCR is non-linearly related to the SO_3 concentration at the SCR inlet
  - Other factors can also influence MOT

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Variables to Consider re: MOT

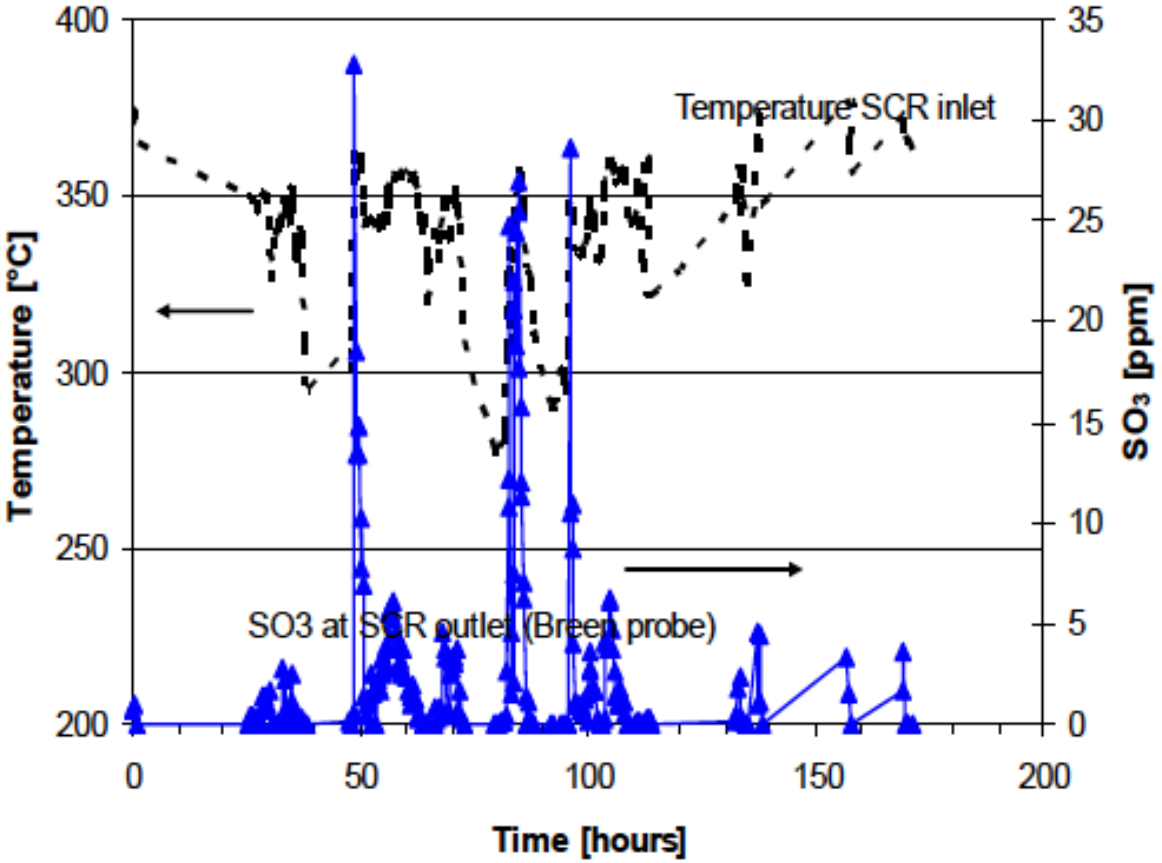
Catalyst pore size is important but can vary with catalyst swaps over time

Ash pluggage will affect actual catalyst surface size and NH_3 rate

Time spent at reduced load will vary actual amount of ABS deposited

Mill configuration, load and O_2 variations affect actual furnace SO_3

SO_3 Release - A Telltale Sign



- Free SO_3 release at load ramp reveals whether ABS inventory was created at low load and, if so, how much
- If you are above MOT, these spikes will be minimal

HALDOR TOPSOE

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Panel

- Cal Lockert – Mississippi Lime Company
- Mitch Lund – Nol-tec
- Darren Hanby - AEP
- Chad Donner – Duke Energy
- Sean Dooley – Clean Air Engineering
- Kanthan Rajendran – Airflow Sciences

Question #1

From your company's perspective, what is the most critical issue for hydrated lime DSI and how are you confronting it?

Question #2

How has the testing industry advanced to keep up with stratification and distribution effects along with shrinking permitted pollutant levels?

Question #3

Tell us how excited you are about lowering Minimum Operating Temperature.

What are some hurdles for testing and implementation of pre-SCR control of SO_3?

Question #4

For HCl removal pre-MATS, nearly all focus was on non-scrubbed low sulfur coal units.

What issues face wet scrubbed Utilities regarding HCl?

Question #5

Arsenic degrades SCR catalyst. What methods are you familiar with for minimizing arsenic poisoning?

Question #6

Either within your company or within the market, what do you feel is the biggest misconception regarding dry sorbent injection?

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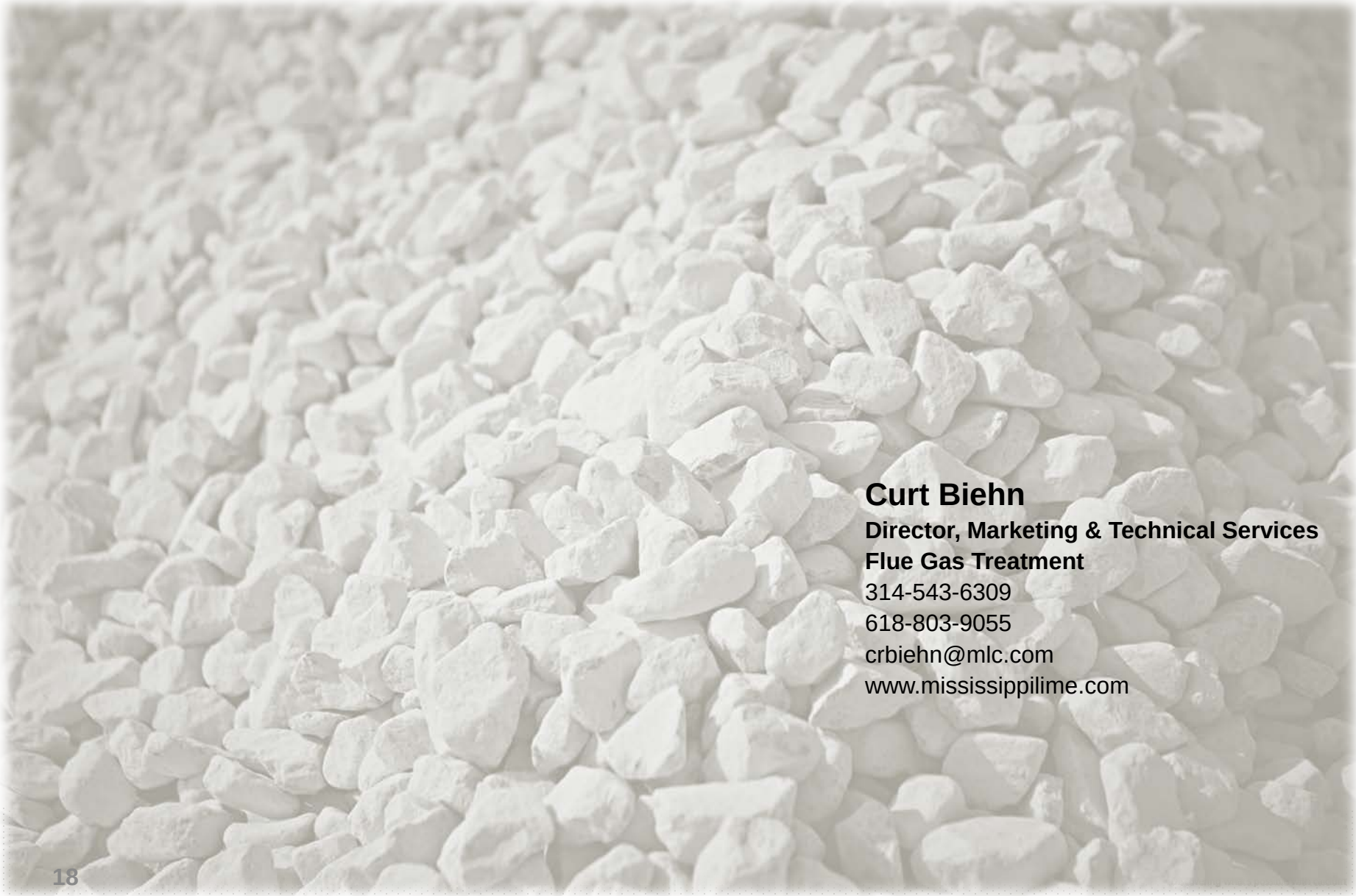

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