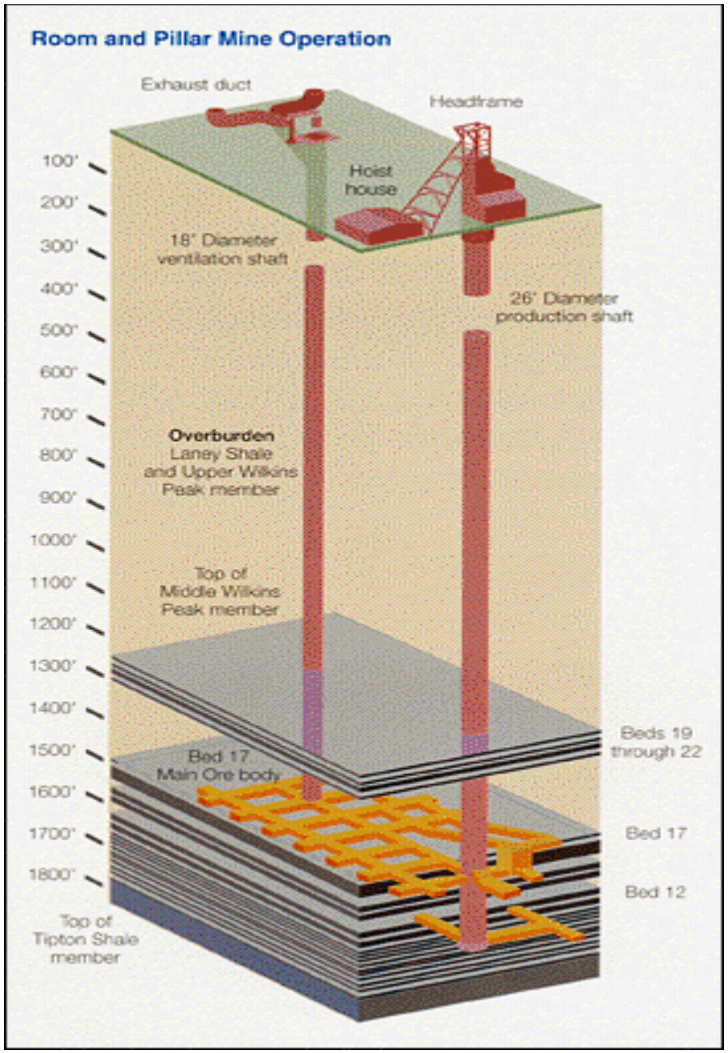
What is Trona?

- Trona is a ore that is mined underground
- Trona is naturally formed sodium sesquicarbonate
- $Na_2CO_3 \bullet NaHCO_3 \bullet 2H_2O$
- Green River formation
- Numerous beds of Trona
- Contain billions of tons of Trona

Solvay Chemicals Operations

- Solvay Chemicals, Inc. Currently Mines Trona Ore at an Approximate Depth of 1500' (457m)
- 12' (3.67m) Thick and of Very High Quality
- Provide Ore for Many Years
- Use Both Longwall Mining and Bore Miners



Room and Pillar Mining

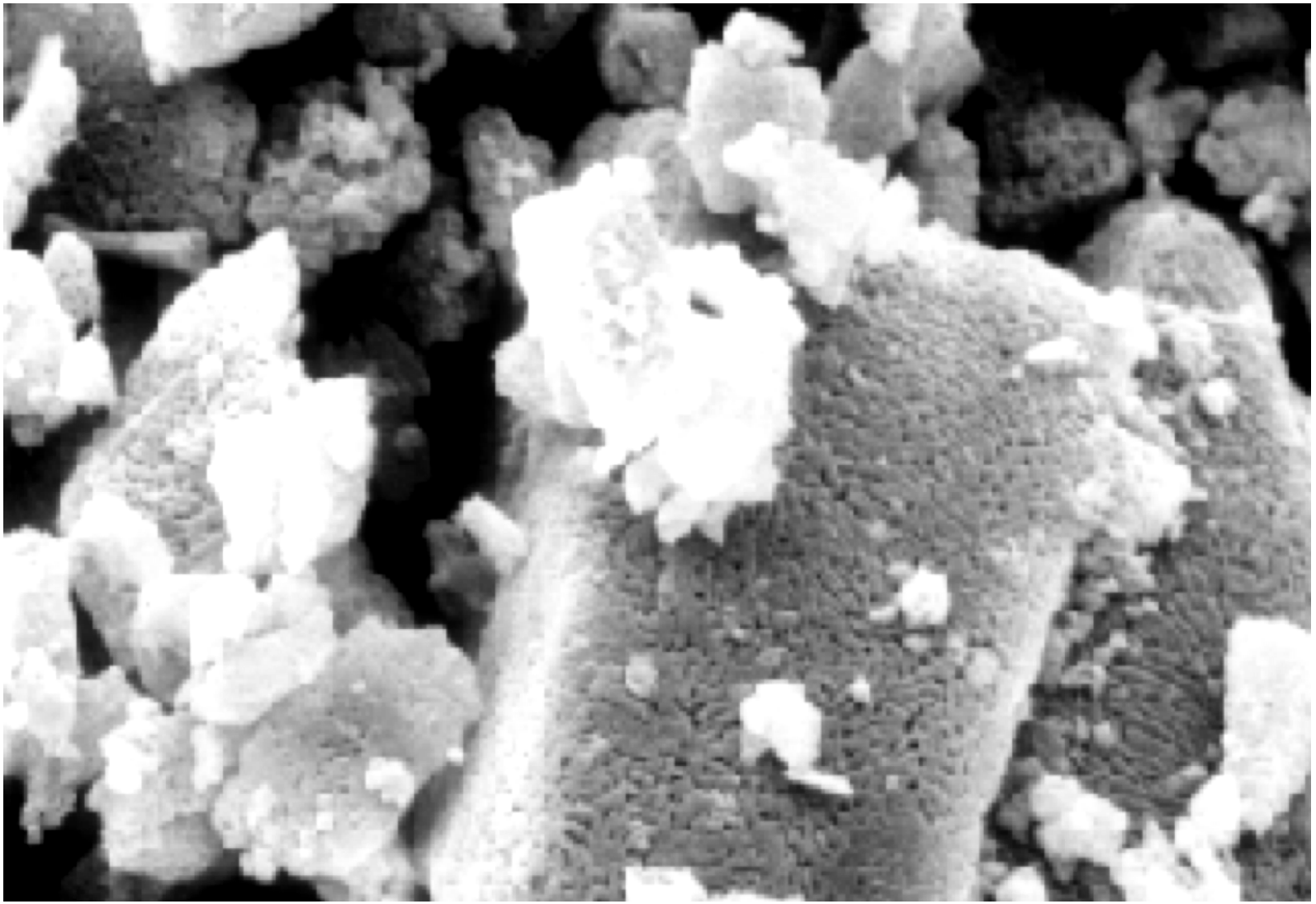
The Surface Plant

Trona Dry Sorbent Injection (DSI)

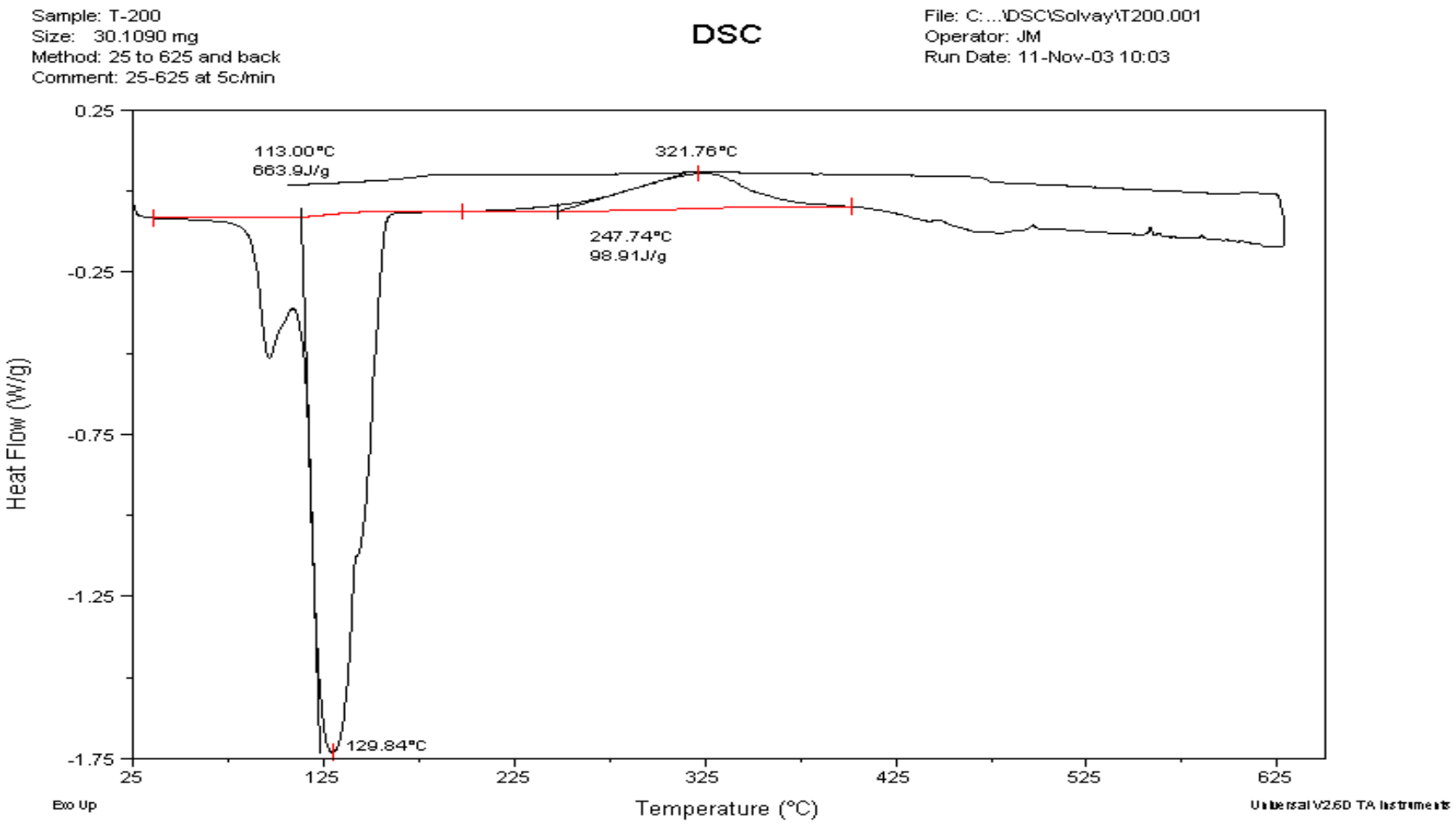
- **“Popcorn Effect”**
  - ...5 to 20 times the original surface area
- **$2(Na_2CO_3 \bullet NaHCO_3 \bullet 2H_2O) \rightarrow$**

  $3Na_2CO_3 + CO_2 + 5H_2O$

Trona SEM After Calcination



Trona DSC



Trona DSI Chemistry

$$2(Na_2CO_3 \bullet NaHCO_3 \bullet 2H_2O) + 3SO_3 \rightarrow 3NaSO_4 + 5H_2O + 4CO_2$$

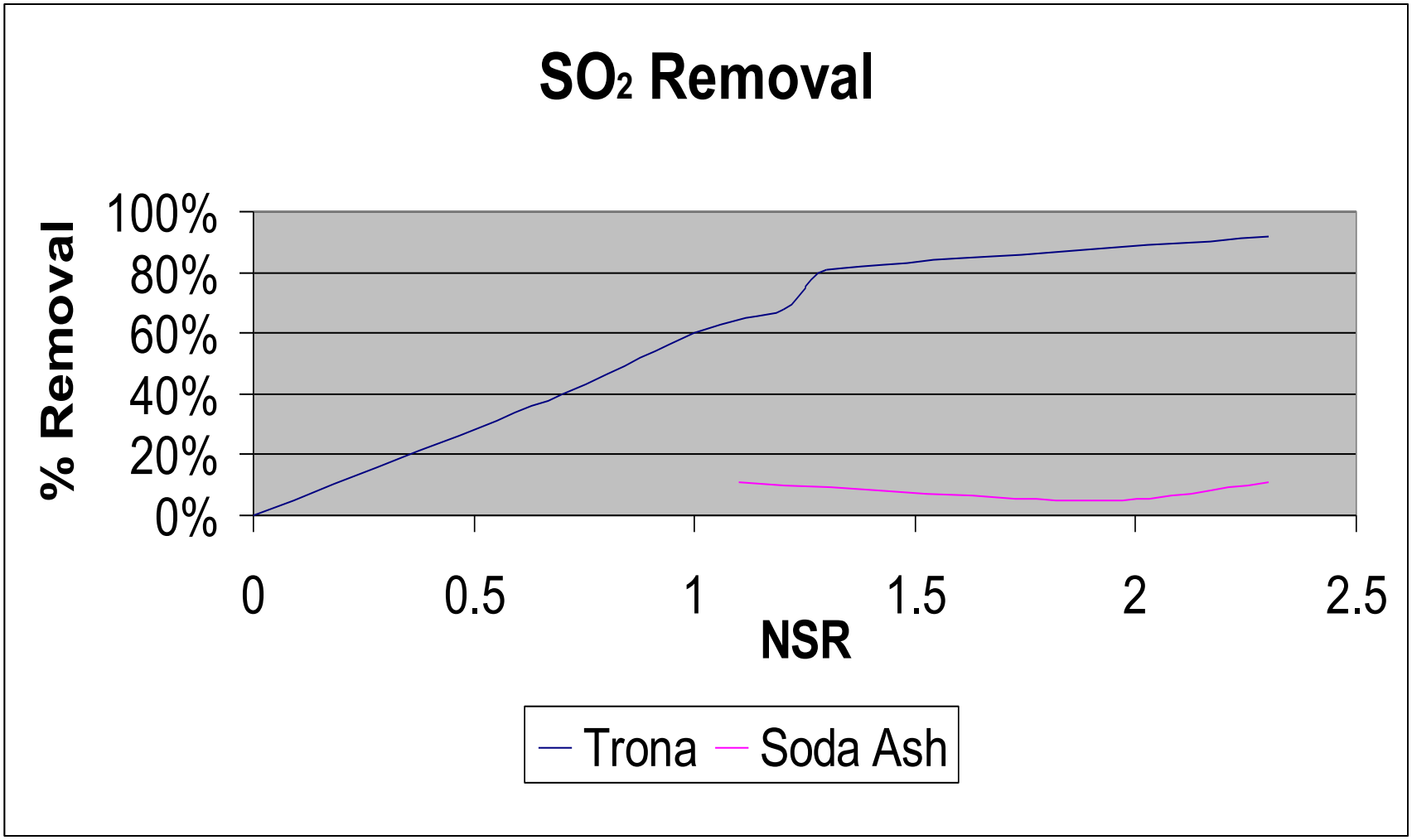
$$2(Na_2CO_3 \bullet NaHCO_3 \bullet 2H_2O) + 3SO_2 \rightarrow 3Na_2SO_3 + 4\,CO_2 + 5H_2O$$

$$3Na_2SO_3 + 1.5O_2 \rightarrow 3Na_2SO_4$$

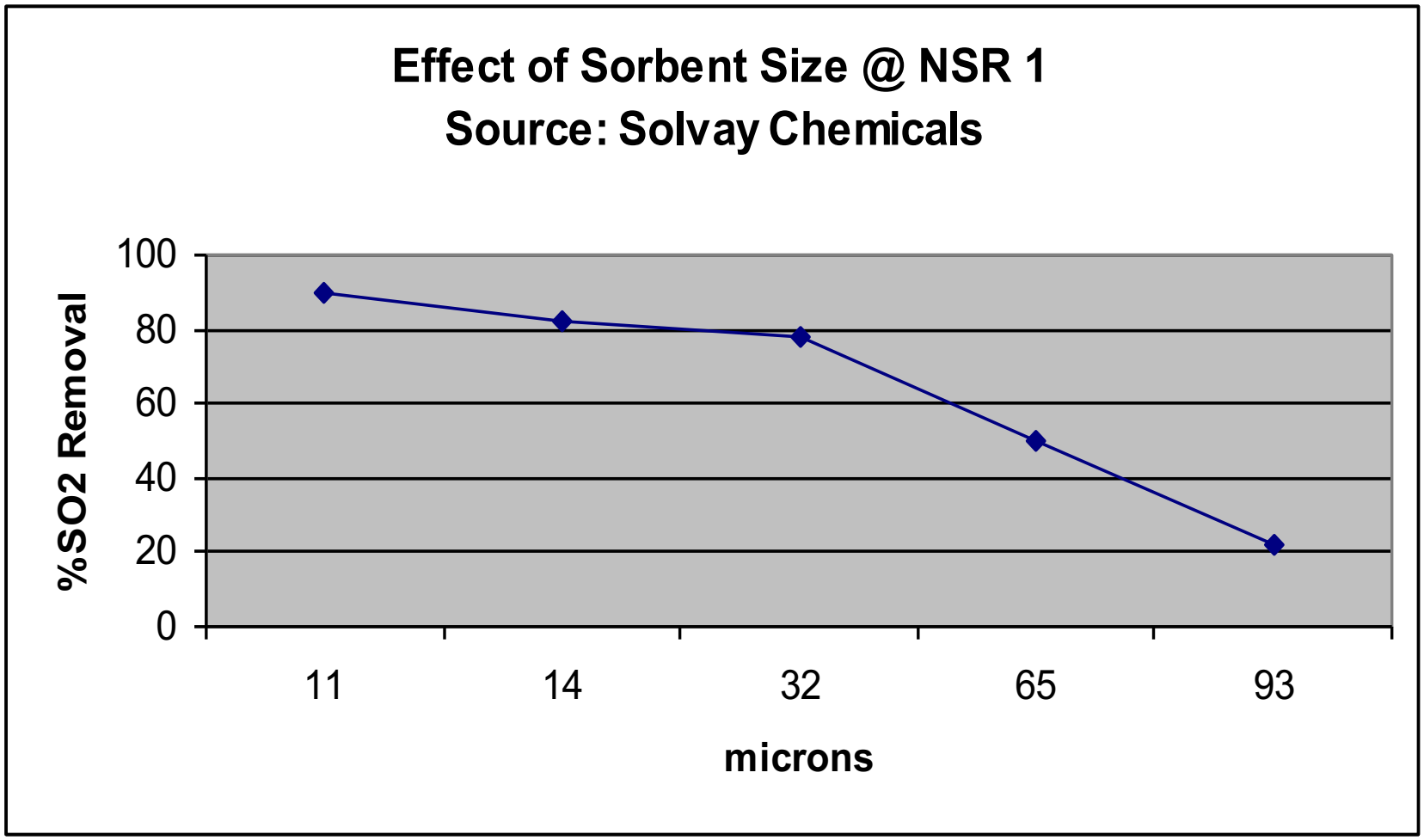
Parameters - Constraints That Affect Sorbent Utilization:

- Sorbent Injection Rate
- NSR (Normalized Stoichiometric Ratio)
- Sorbent Particle Size
- Sorbent Residence Time In The Flue Gas Stream
- Sorbent Penetration And Mixing Within The Flue Gas
- Particulate Control Device Used
- Other Acids

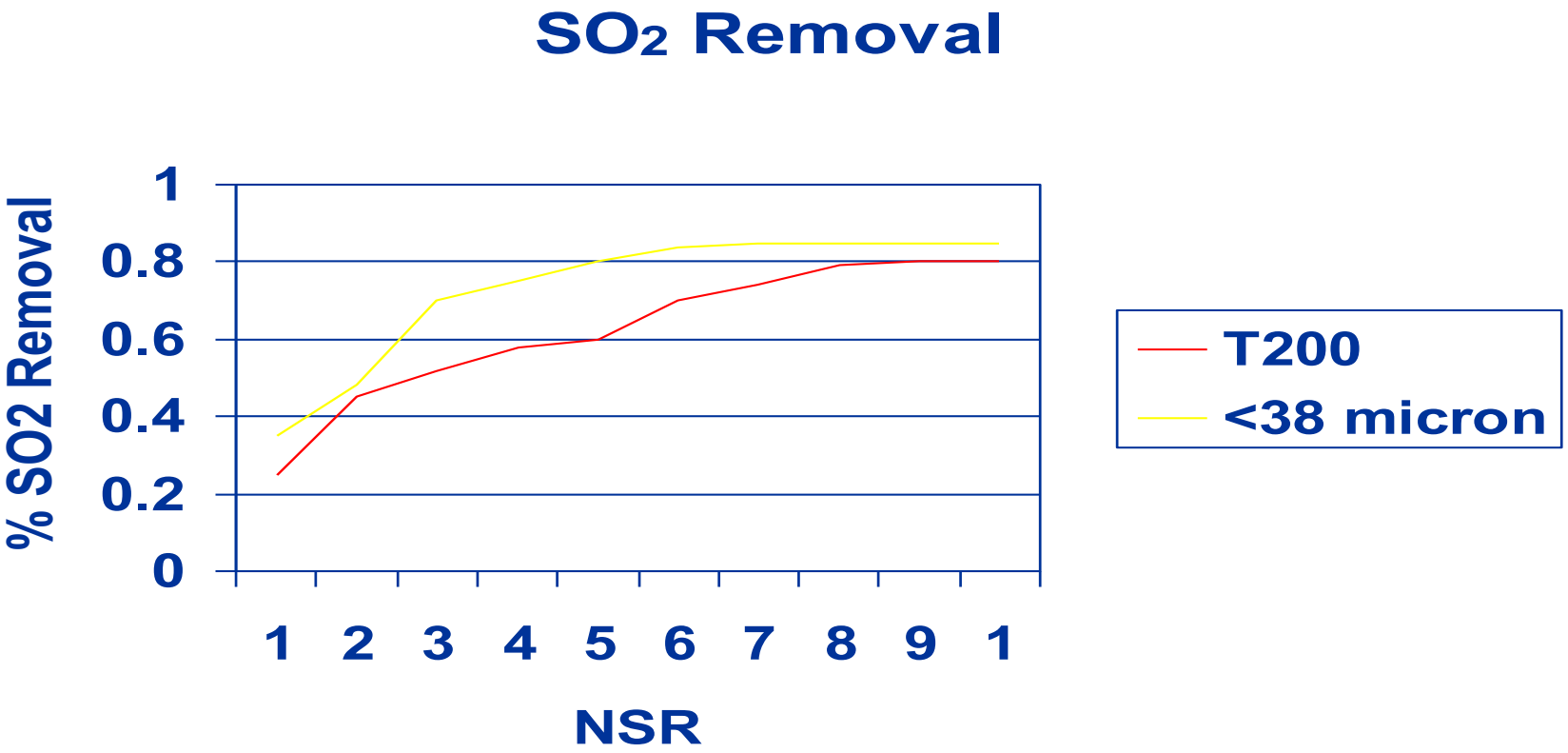
Trona DSI with Baghouse



Impact of Particle Size on Trona Performance @325°F



Trona DSI @ Baghouse Conditions



- PSD is very important to SO_2 Removal Efficiency.

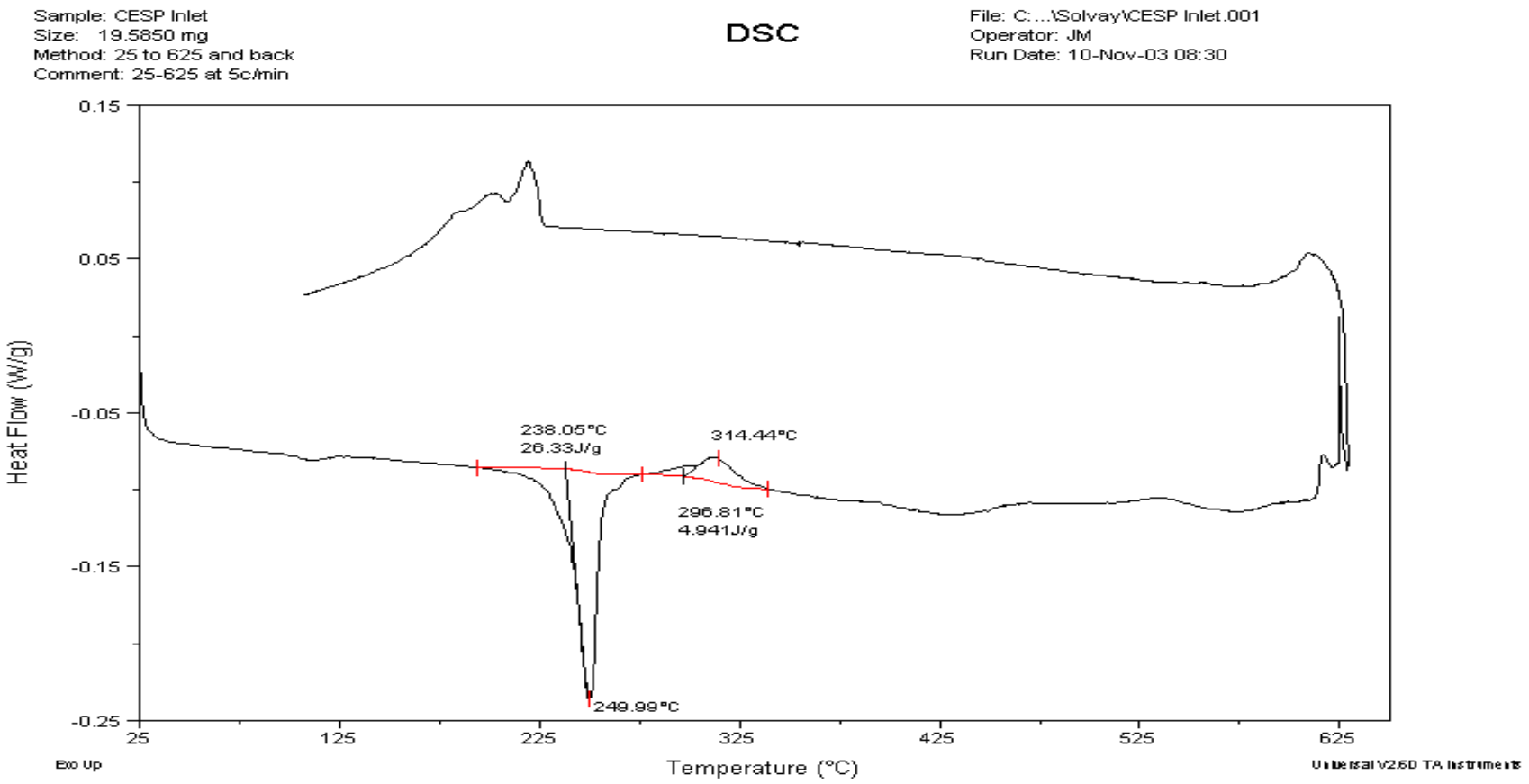
Case Study at a Glass Furnace in California

- A Glass Plant Was Having Operational Problems With A Dry Sorbent SO_x Mitigation System
- Sodium Bicarbonate Crystals Were Being Milled And Then Dry Injected Into The Duct From The Furnace Just Prior To The Hot Side ESP
- The Perf Plates Would Plug Quickly Causing Frequent Shutdowns
- After XRD And DSC Analyses They Lowered The Injection Temperature By Adding Outside Air.
- The Lower Injection Temperature Delayed The Pluggage By Several Days But Did Not Solve The Problem

ESP Perf Plates Using Sodium Bicarbonate >700°F

Perf Plates Using Sodium Bicarbonate at 550°F

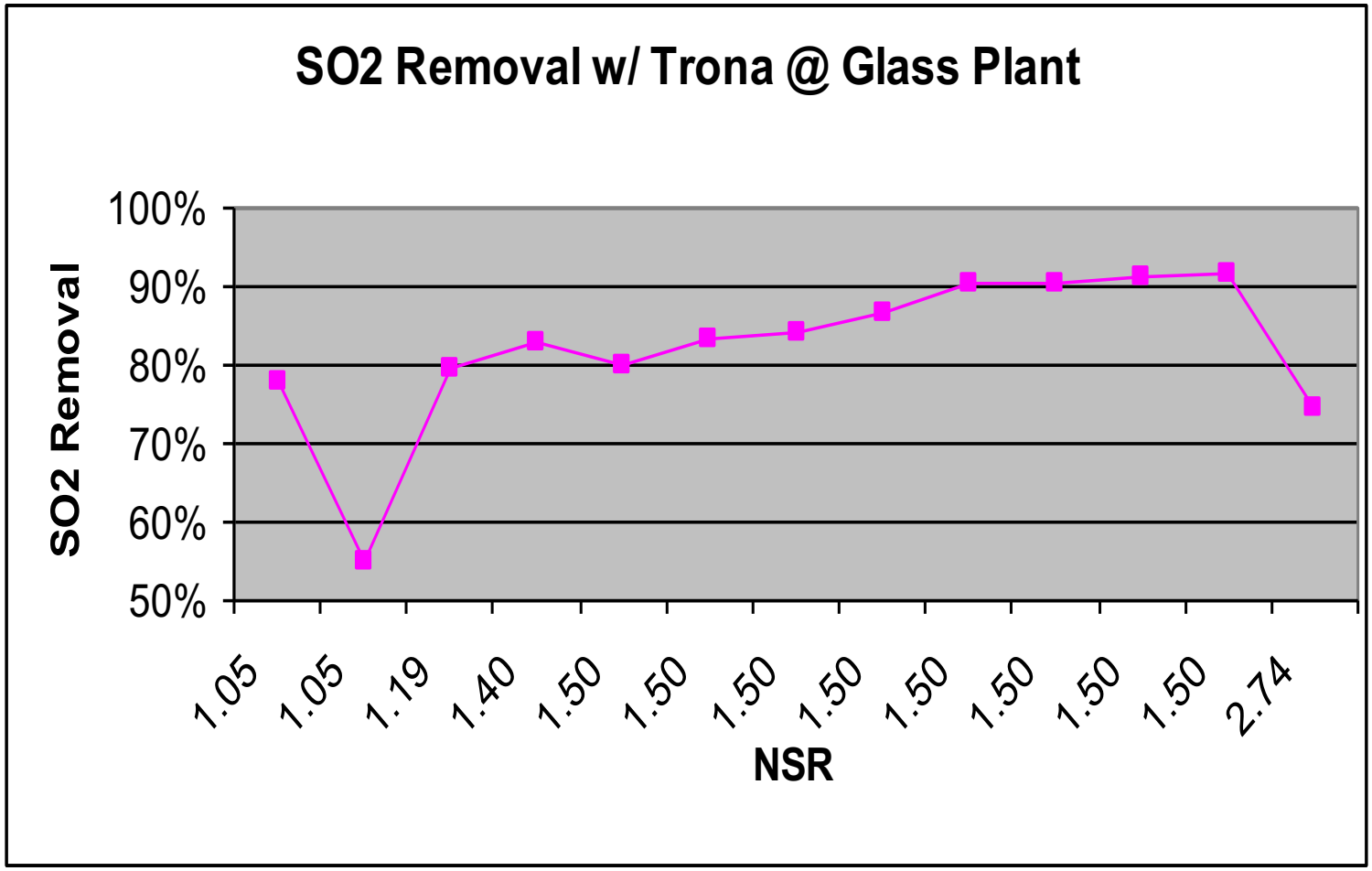
Sodium Sulphate III



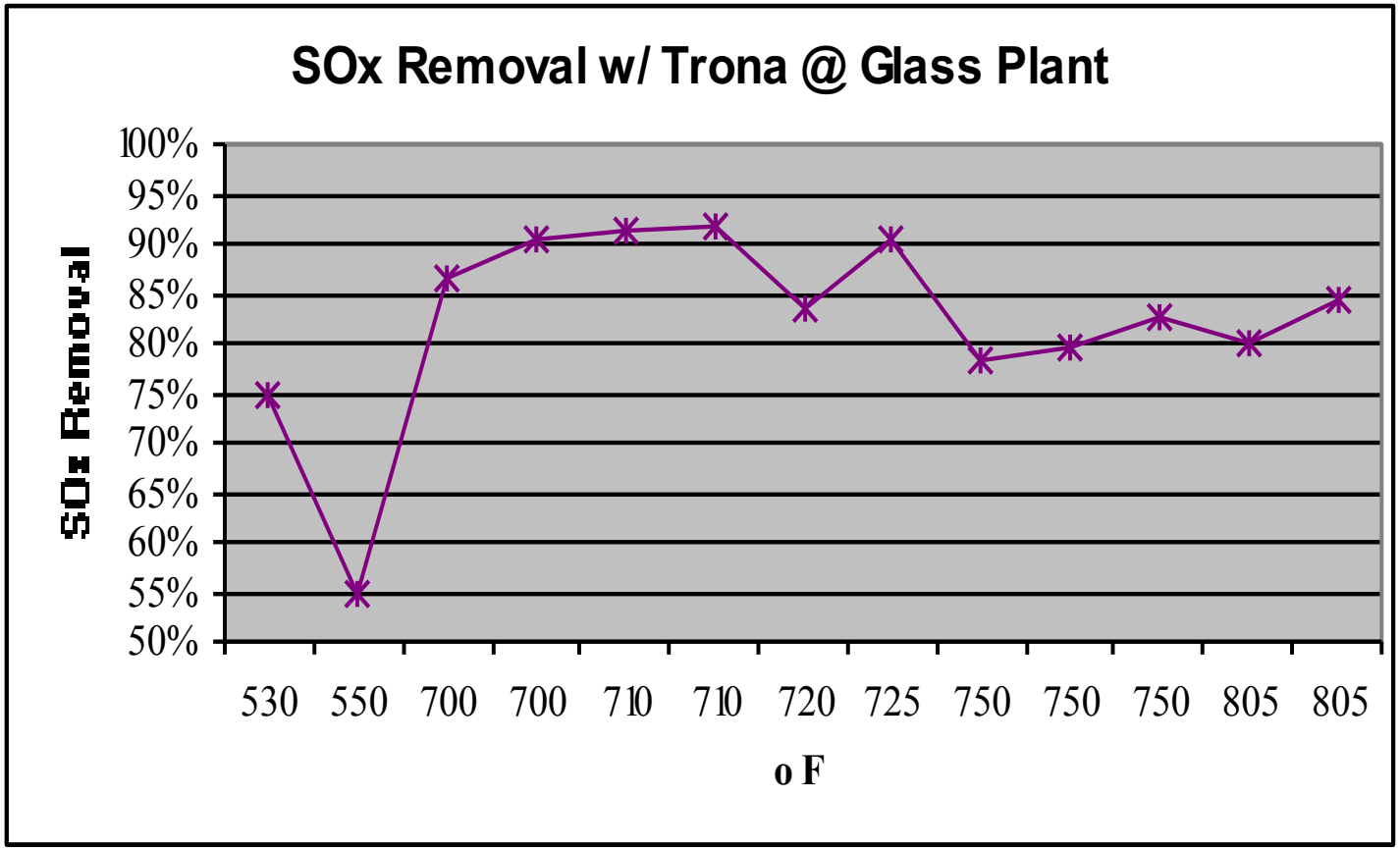
Case Study at a Glass Plant in California (continued)

- The Glass Company Decided To Test Trona
- T200 Performed Much Better At The >700°F Injection Temperature Range
  - Higher SO_x Removals
  - Higher Utilization Efficiency
  - Air Cooling At The Injection Point Is Not Necessary
  - Milling T200 Had Only A 5% Utilization Efficiency Improvement Over Sodium Bicarbonate
- No Plugging Occurred

Trona DSI

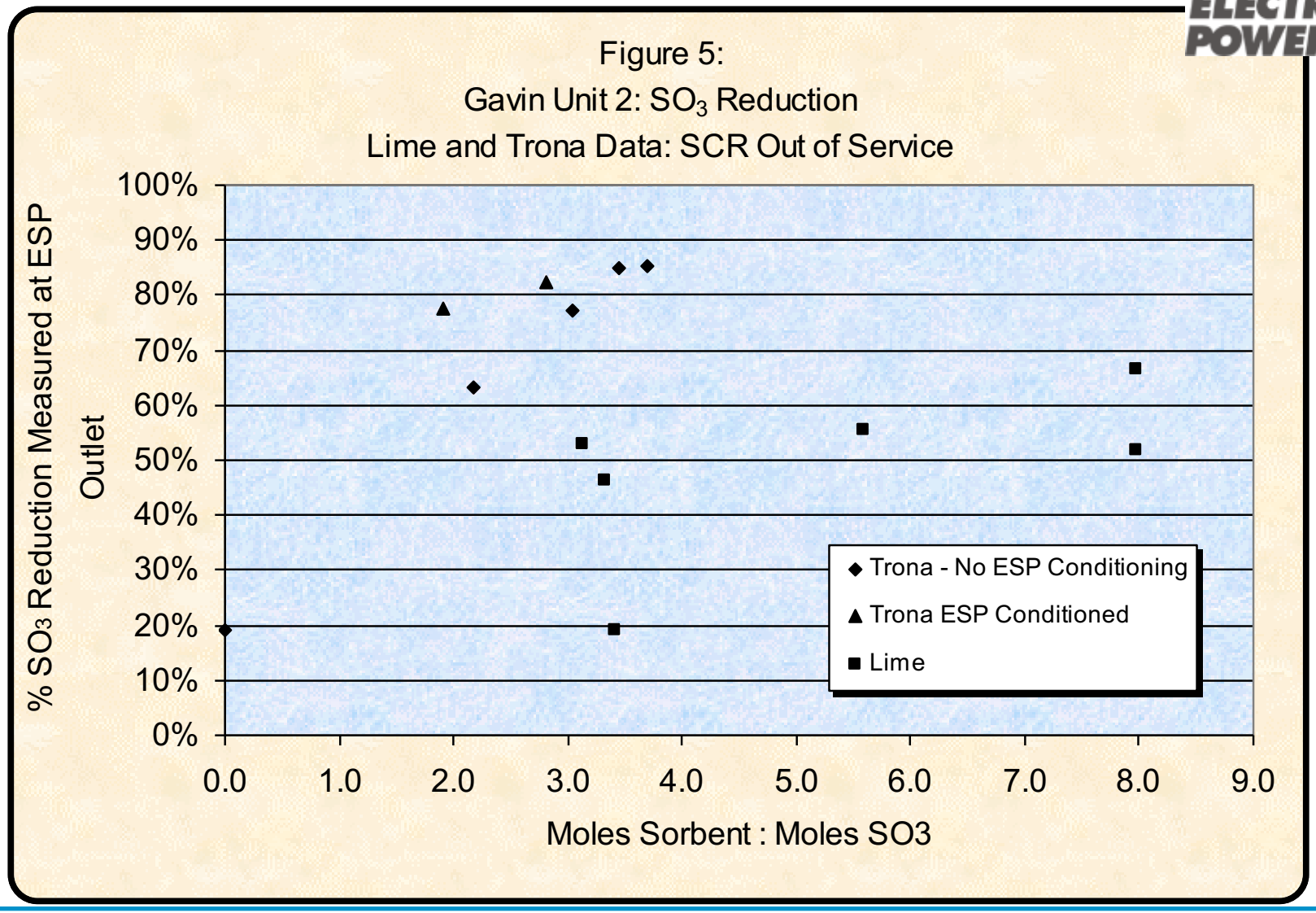


Trona DSI



Perf Plate Before Hot Side of ESP in Previous Slide After Two Weeks of T200 DSI and still "clean as a whistle"

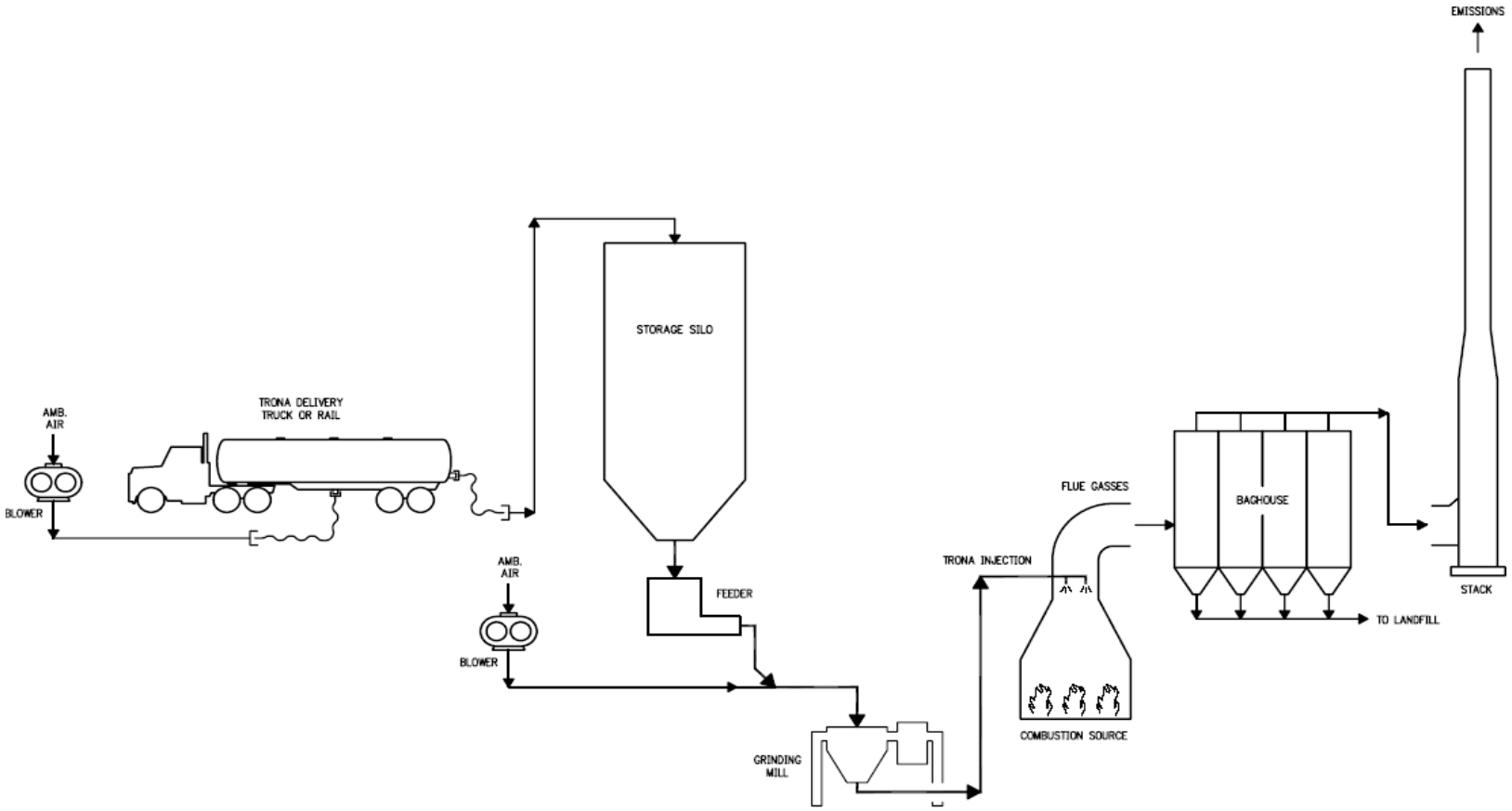
Test Data, continued



Trona DSI Benefits

- High Removals With Low Cost Position
  - Low Initial Capital
  - Low Sorbent Cost
  - High SO_x Removal
- Saved The Glass Plant $$$/Ton Of SO_x Removal Costs Via SBC
- Milling Improved T200 SO_x Removal Efficiency By 5 - 10%
- Spent Sorbent And Unused Sorbent Can Be Sent Back To Furnace

Typical Trona DSI Loading/Storage System



TRONA INJECTION SYSTEM FOR SO2 REDUCTION

Dry Sorbent Injection (DSI)

- **Dry Sorbent Injection Of T200 Is A Very Cost Effective Way To Mitigate Acid Gas Emissions.**
  - **Low Capital**
  - **Does Not Require Heating Of Tanks Or Lines**
  - **Requires Few Mechanical Parts**
  - **Compatible With ESPs, Baghouses And Most Wet Scrubbers**
- **Will React With Acid Gases Over A Wide Temperature Range (275^0F - 1800^0F)**
- **Trona Sorbent Specifically Designed To Be Used For Neutralization Of Acid Gases That Can Be In Emissions From Boilers, Kilns, Combustors, Furnaces And Incinerators.**

DSI of Trona

- Because Of The Positive Effect Sodium Has On The Resistivity Of Particles It Is Not Detrimental To The Operation Of An ESP And Can Actually Enhance It's Operation
- Trona Will Act As A Precoat On Baghouse Filter Media
- Trona for DSI is A Fine (D_{50} 30-35µ) Material That Can Be Easily Aerated For Pneumatic Transfer
- Trona for DSI Can Be Used As Is Or Milled To A Smaller Size.

The End