

# Dry Sorbent Injection of Sodium Sorbents by Solvay Chemicals

Emission Control and Measurement  
Workshop

March 24-25, 2010

- What are the sodium sorbents?
  - We'll talk about Trona and Sodium Bicarbonate
- How effective are sodium sorbents in mitigating  $\text{SO}_2$  and  $\text{SO}_3$ ?
  - We'll review some data.
- Which sorbent is better?
  - We'll discuss the factors affecting the decision.
- What parameters impact the effectiveness of DSI?
  - We'll look at how we optimize systems and factors that limit effectiveness.

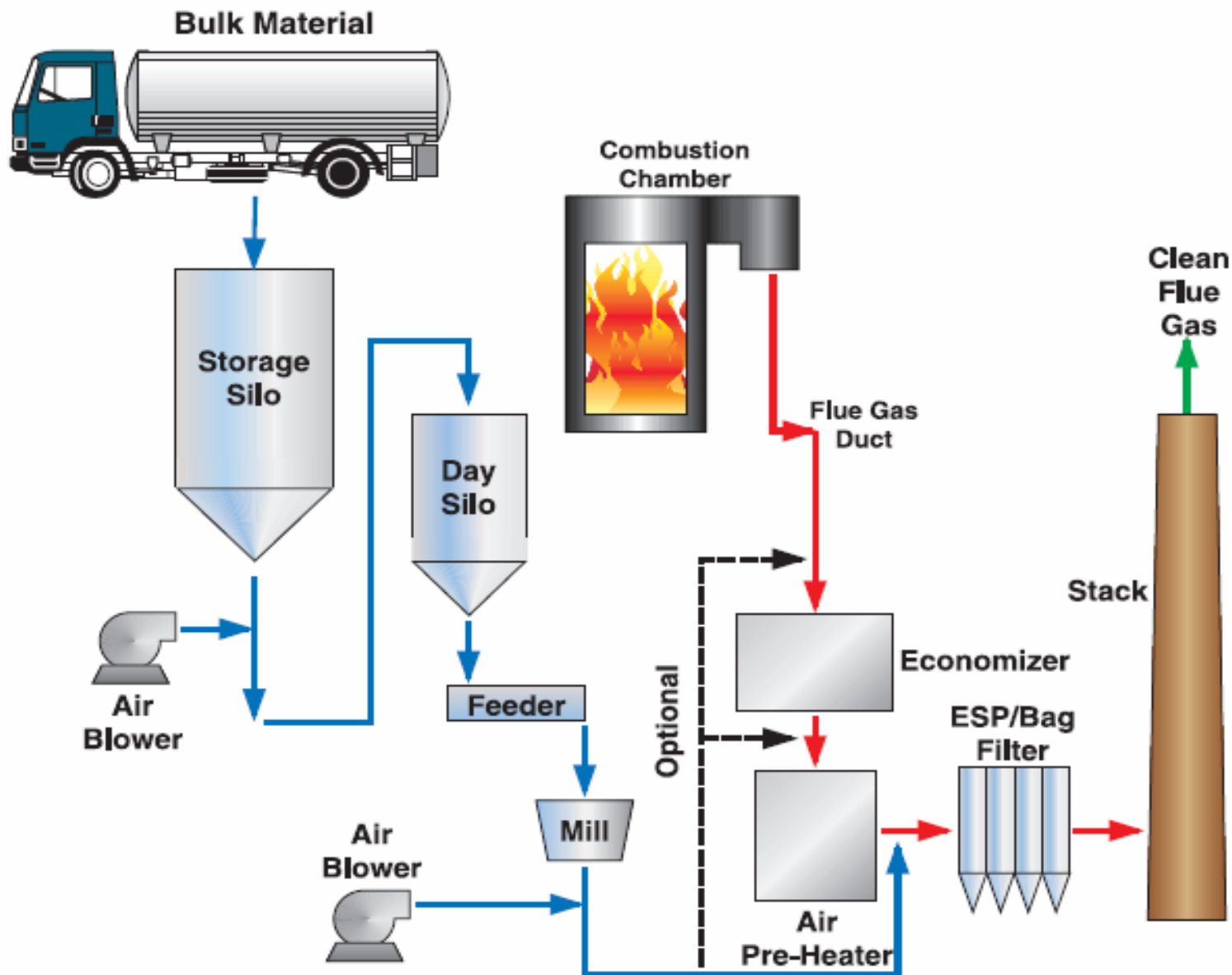
# What Is Trona?



- It is a naturally formed sodium sesquicarbonate rock
  - $(\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O})$
  - The Green River WY deposit is the largest and purest in the world
- Solvay mills this rock into a fine powder
  - Average particle size 30 – 35 microns
  - Material for FGD is sold under the trade name SOLVAir Select 200
  - Select 200 is the product known as trona in the industry
- Select 200 is very dry, typically less than 0.03% moisture
  - It is a good idea to keep it dry, wet trona is tough to handle.
  - Contact with water will cause problems.
- Select 200 can compact while stored
- Select 200 calcines instantly at 280°F
  - Trona gives up water when it calcines
  - At 140°F Trona begins to calcine

- Sodium Bicarbonate is a downstream product made from Trona
  - It is the same baking soda you add to food
  - It is a purified processed product made from soda ash, so it is more expensive
  - But is much more reactive with  $\text{SO}_2$
- Bicarbonate has to be milled prior to use
  - Milling on site to d90 less than 20 microns with direct injection gives the best results
  - Premilled material with a D90 less than 40 microns is available
  - Handling issues become severe as d90 approaches 20 microns.
- New capacity for sodium bicarbonate
  - A new process that skips the soda ash step makes a more economical Flue Gas grade.

# Typical Dry Sorbent Injection System



# Advantages of Sodium DSI



- Dry Sorbent Injection systems are the lowest capital cost option to treat acid gases.
  - Small utilities and industrial boilers can't afford wet scrubbers
- Sodium DSI is compatible with ESP particulate control
  - Even with higher loading, sodium salts reduce ash resistivity and usually lower opacity and particulate emissions.
- Sodium DSI is also effective on HCl and HF
- Removal rates can adapt to changing conditions by adjusting the feed rate.
  - Fuel changes, load changes, regulation changes

# Trona compared to Lime

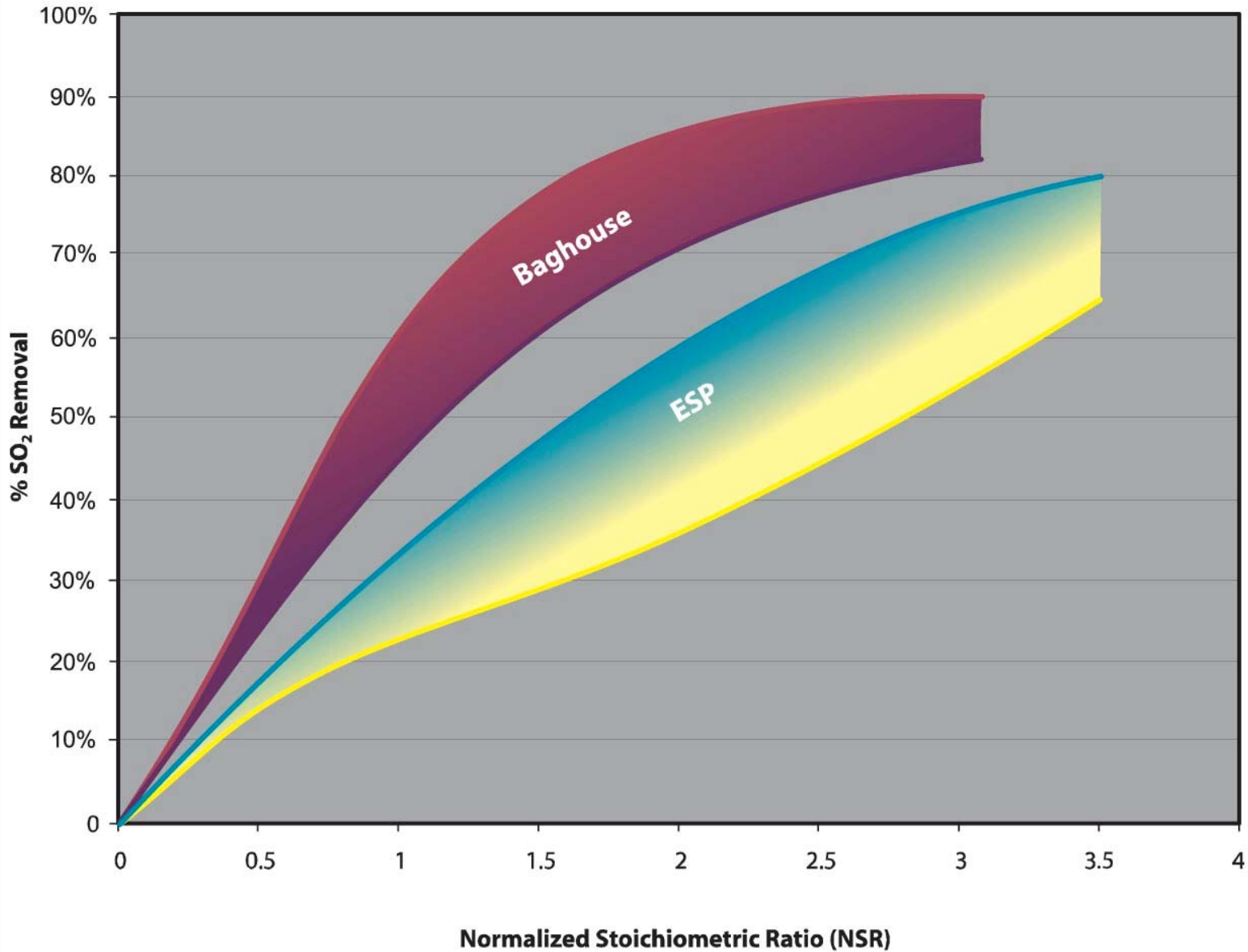


- Trona is more efficient than lime so less material is needed
- Trona is easier to handle and less prone to plugging
- Trona enhances ESP performance
- Trona can be added further upstream, even ahead of the economizer
- Lime is less expensive per ton on a delivered basis
  - Delivered trona costs are highly freight dependant
- Lime is more compatible with beneficial use of fly ash
  - Sodium levels in the ash of less than 1.5% are typically acceptable

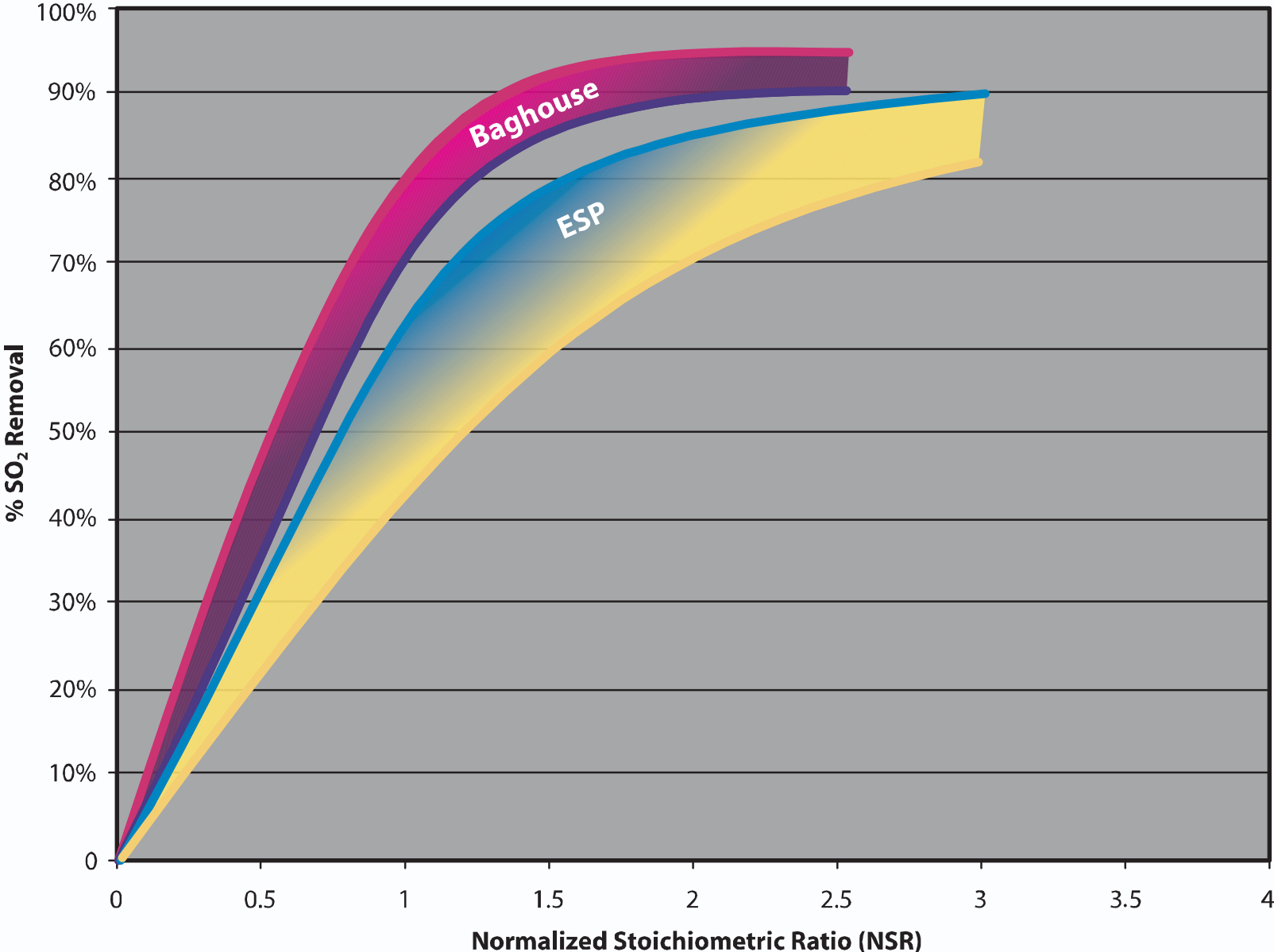
## ● Normalized Stoichiometric Ratio

- MW trona is 226      MW SO<sub>2</sub> is 64      MW SO<sub>3</sub> is 80
- **2 moles trona for every 3 moles SO<sub>2</sub> or  $452/192 = 2.35$**
- **2 moles trona for every 3 moles SO<sub>3</sub> or  $452/240 = 1.88$**
- MW bicarbonate is 84
- **2 moles bicarbonate for every mole of SO<sub>2</sub> or  $168/64 = 2.62$**
- *To fully calculate the amount of sorbent for an NSR of 1, all acid gasses must be accounted for. For trona, figure 97.5% purity.*

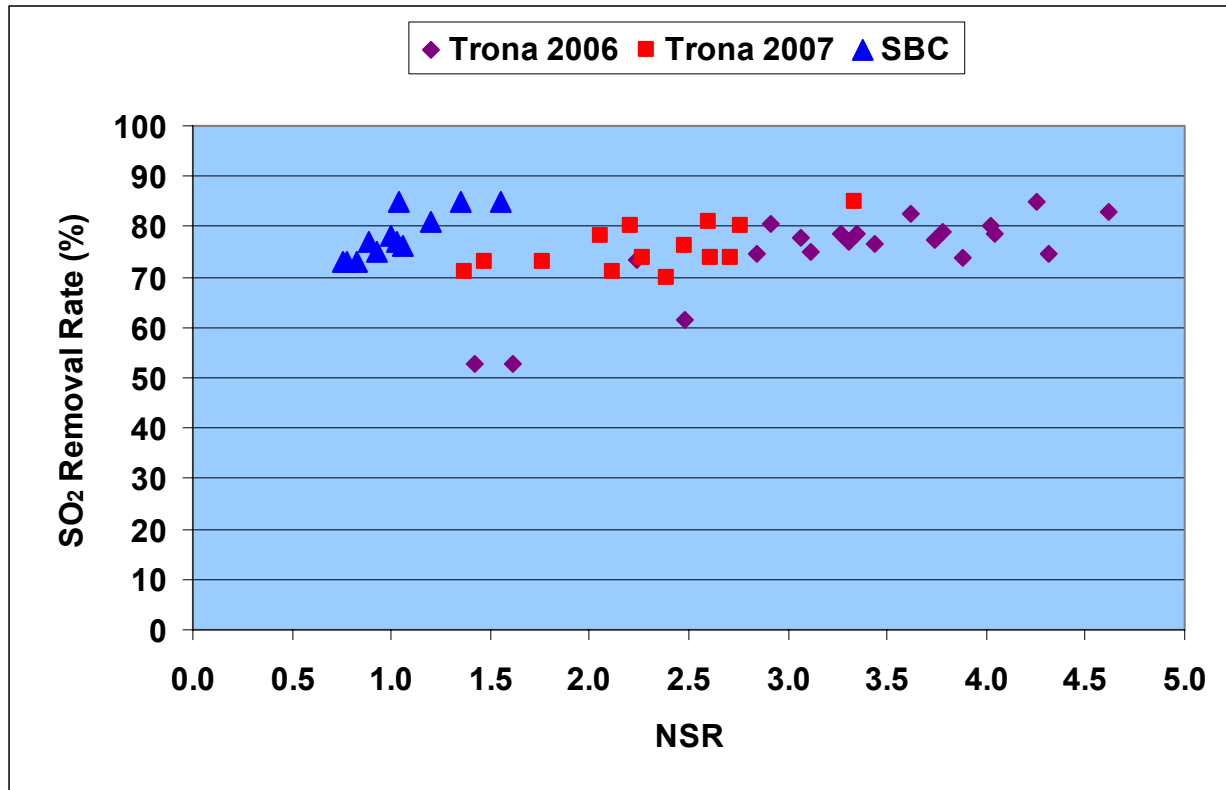
# Trona Performance Curve



# Sodium Bicarbonate Performance Curve



# Comparison of SO<sub>2</sub> Treatment Rates with Trona and Sodium Bicarbonate (SBC)



- The 2006 data was obtained during a test using a temporary set up.
- The 2007 data was generated from a permanent installation
- Unmilled trona Select 200:  $d_{90} = 140 \mu\text{m}$ ,  $d_{50} = 30 \mu\text{m}$

# Should You Use Trona or Sodium Bicarbonate

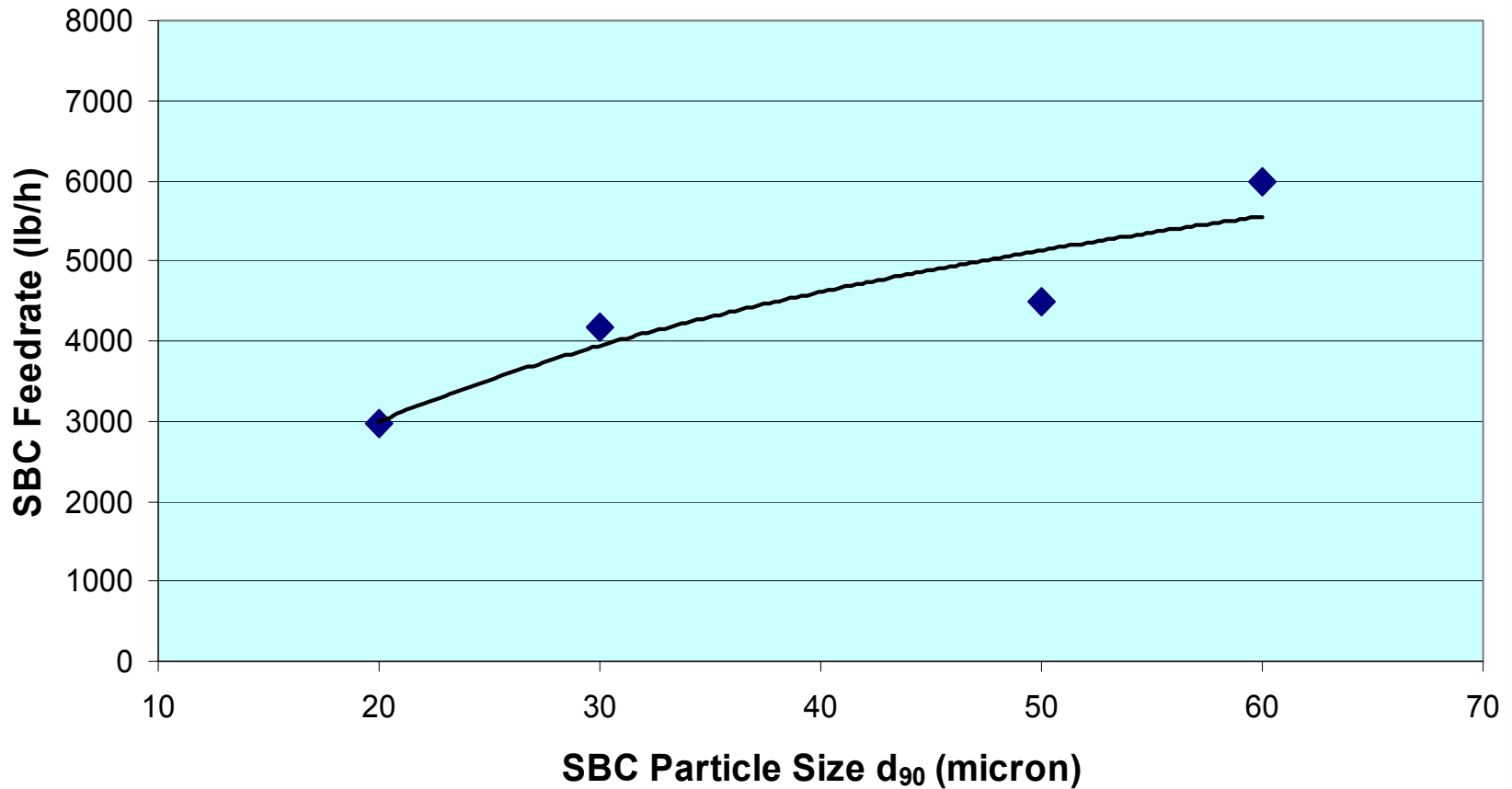


- Sodium bicarbonate becomes more economical to use than trona as the following situations exist
  - An ESP is the particulate control device
  - Higher SO<sub>2</sub> removals are required
  - Injection is after the air heater
    - Bicarbonate needs less than 800°F
    - Trona efficiency increases as temperature and residence time increase
  - On site milling is available
  - Freight costs are high
  - Fly ash disposal costs are high
- Use of sodium sorbents results in higher sodium content in the fly ash. The customers should check the fly ash properties for beneficial applications or disposal.

# Effect of Sodium Bicarbonate Particle Size



### Effect of SBC Particle Size at Same SO<sub>2</sub> Removal Rate



**\* Outlet SO<sub>2</sub> concentration @ 0.3 lb/mmBTU for all tests**

- Higher sodium content in the fly ash.
- Ashes from SO<sub>2</sub> treatment typically not suitable for applications in concrete or structural fill
- Solubility of sodium compounds in the fly ash (i.e. Na<sub>2</sub>SO<sub>4</sub>, Na<sub>2</sub>CO<sub>3</sub>)
- Disposal issues should be investigated early in the process. Customers encouraged to check properties and work closely with their fly ash marketers.

- High removal efficiencies for HCl and HF
- Mercury removal is enhanced at locations that have high sulfur coal
- Selenium and arsenic are also removed from the flue gas.

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