Acid Gas Removal with Trona

Focus on HCl Reduction

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Overview

- Natron$_x$ overview
- Trona Chemistry
- Trials Scenarios
  - Boiler 1
    - HF and HCl mitigation
  - Boiler 2
    - APH inlet vs. outlet
  - Boiler 3
    - Milled vs. Unmilled trona
- Conclusion /Questions

Natron$_X$ Overview

- Natron$_X$ Technologies, LLC is a partnership created by
  - FMC Corporation
  - Church & Dwight Co., Inc.
  - Tata Chemicals

- The Scope of the Natron$_X$ Technologies :
  - To develop, manufacture, market, sell and distribute sodium products for use in dry injection acid gas scrubbing processes

Trona Sorbent Reactions

Trona- (EnProve ™ TR)

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

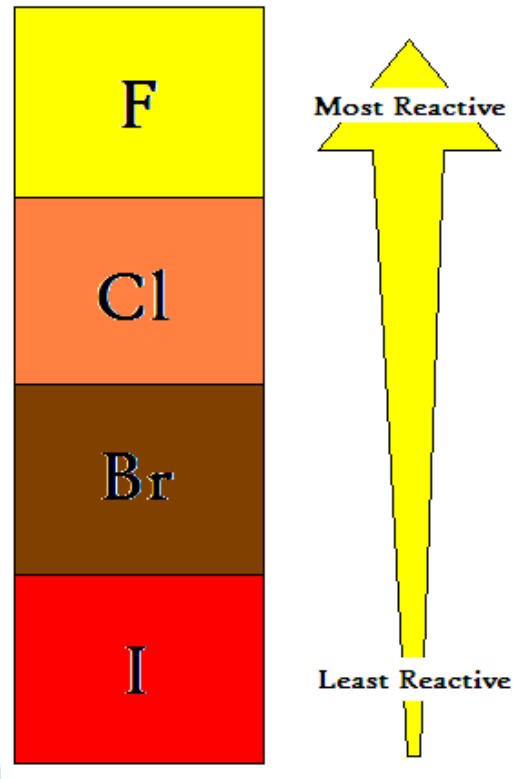
$Na_2CO_3 \bullet NaHCO_3 \bullet 2H_2O + 3\ HCl \rightarrow 3\ NaCl + 2\ CO_2 + 4\ H_2O$

$Na_2CO_3 \bullet NaHCO_3 \bullet 2H_2O + 3\ HF \rightarrow 3\ NaF + 2\ CO_2 + 4\ H_2O$

Stoichiometry

- 2.4 lbs of Trona neutralizes 1 lb of SO2 (g)
- 2.1 lbs of Trona neutralizes 1 lb of HCl (g)
- 3.8 lbs of Trona neutralizes 1 lb of HF (g)

Reaction Order



- Reaction Speed from fastest to slowest

HF

- Most reactive acid gas

HCl

- Acid base reaction

SO2

- Multi-step reaction

Trona Sorbent Reactions

$$NSR = \frac{\frac{lbs}{hr} Trona}{\left(\frac{mmBtu}{hr} heat\_input \times \frac{lbs}{mmBtu} acid\ gas \right) \times \left(\frac{226 \frac{g}{mol} trona}{\frac{g}{mol} acidgas} \times \frac{mol\ \ Trona\ \ theoreticdly\ reacted}{mol\ \ acidgas\ \ theoreticdly\ reacted} \right)}$$

- NSR
  - An adjusted ratio of showing the actual usage over theoretical usage of the reaction compared to ideal conditions

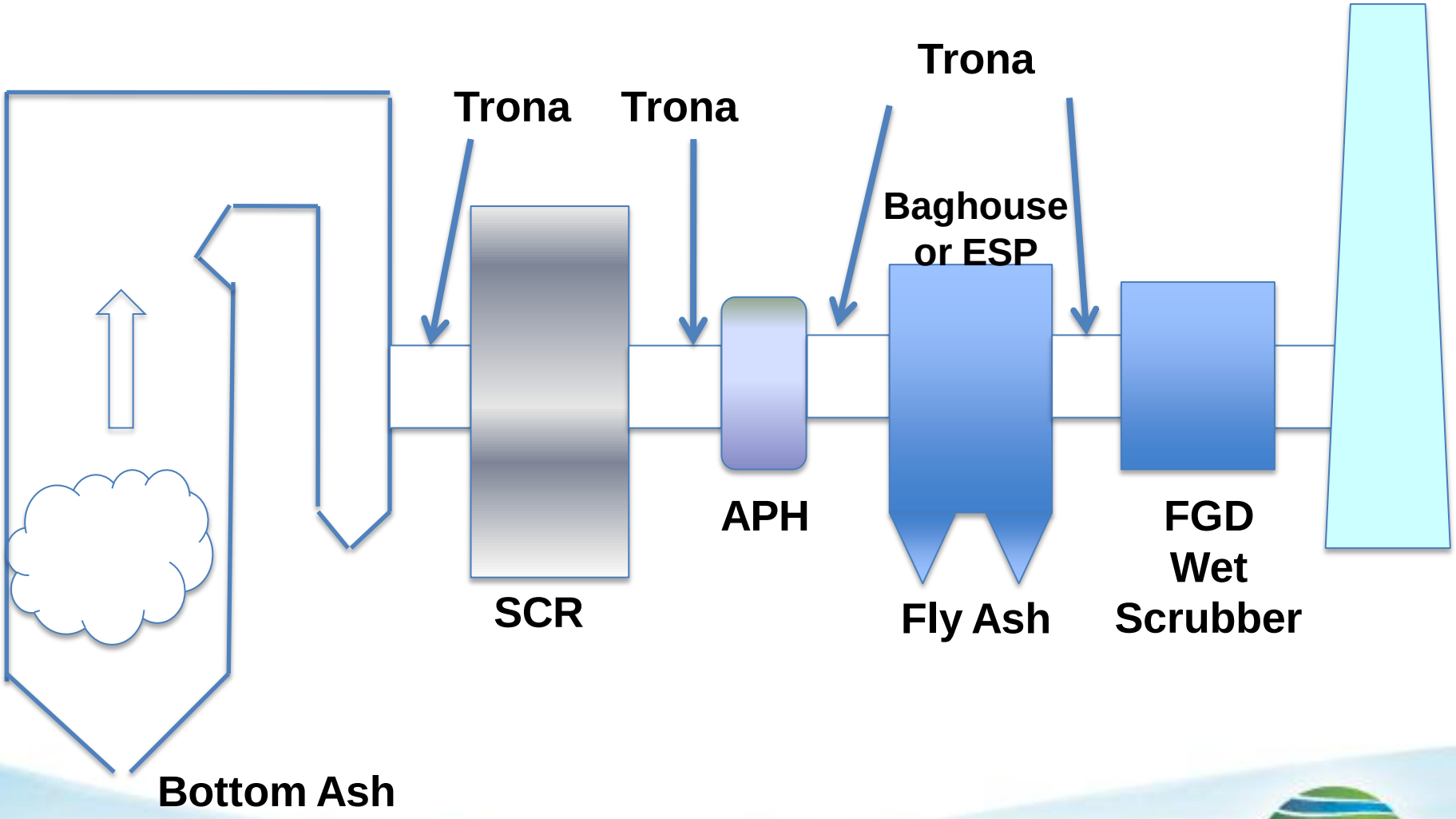
Trial Success Factors

- Sorbent Particle Size
- Residence time to Particulate collector
- Temperature of injection point
- Particulate collection equipment
  - Baghouse or ESP
- Material Distribution
- Material Handling
  - Moisture
  - Pre-calcination

Trona Milling

- Particle Size unmilled trona:D50 ~30 microns
- Particle Size milled trona: D50 ~22 microns
- Post Mill Temperature: 105° F

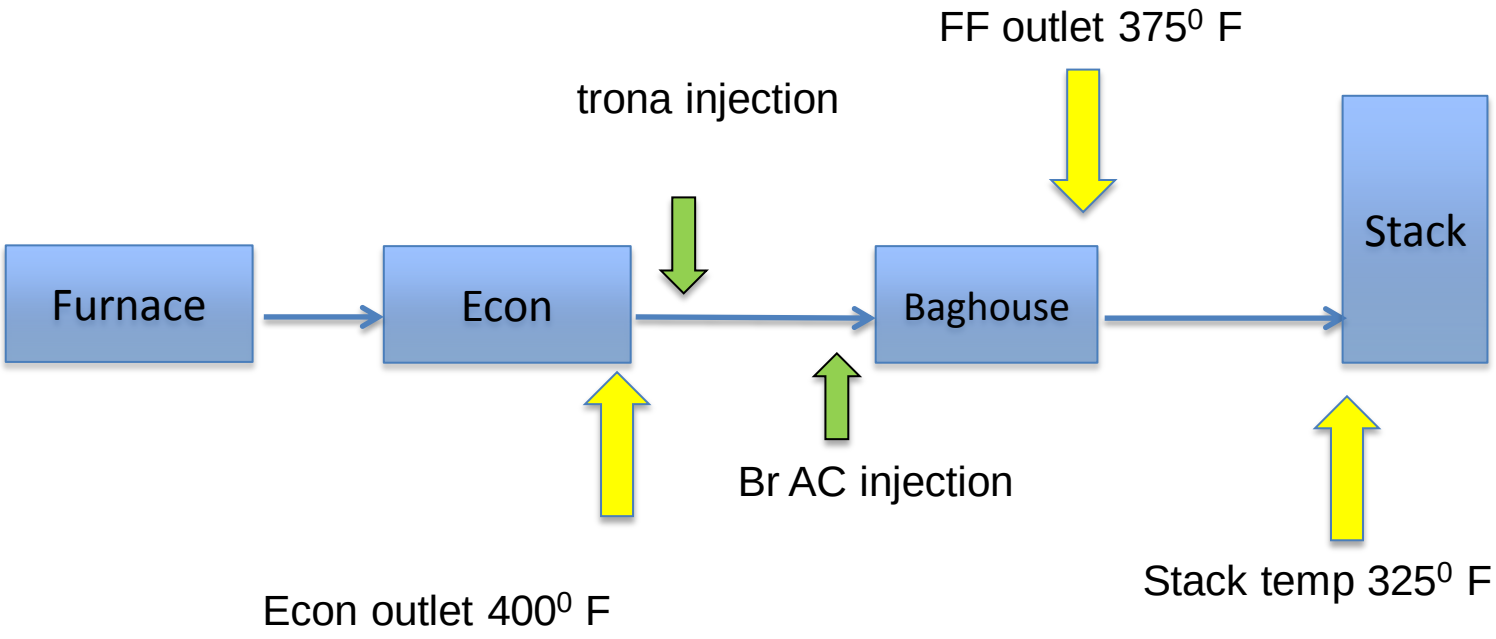
Sodium Alkali Typical Injection Locations



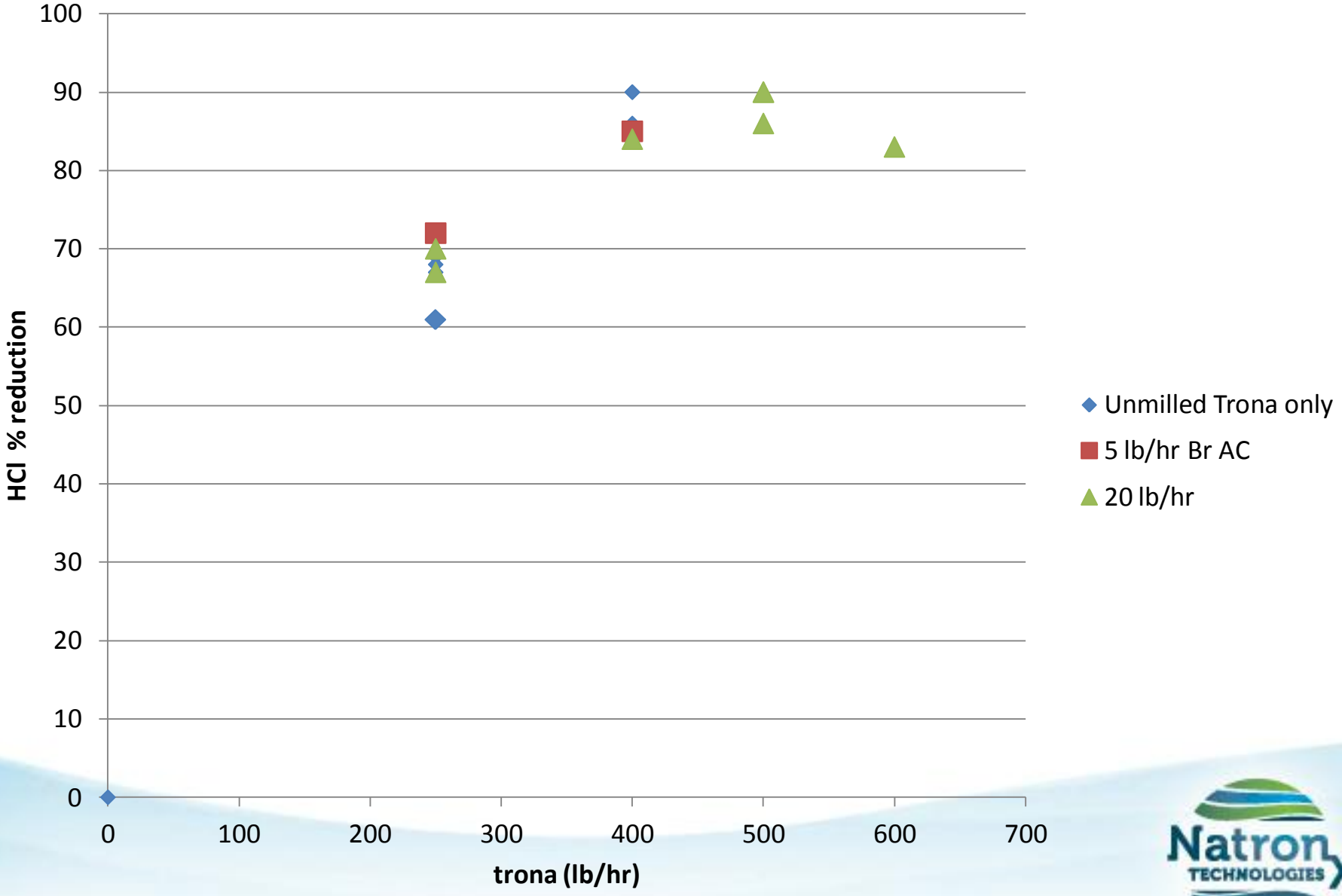
Industrial Boiler Trial - Plant 1

- Size: 70 MW
- Fuel: Bituminous Coal
- Baseline HCl: 50 ppm
- Baseline SO_2: 500 ppm
- Particulate Collector: baghouse
- Injection points
  - Upstream of baghouse: 370-390^{o} F
- Reduction Goal: 80% removal of HCl

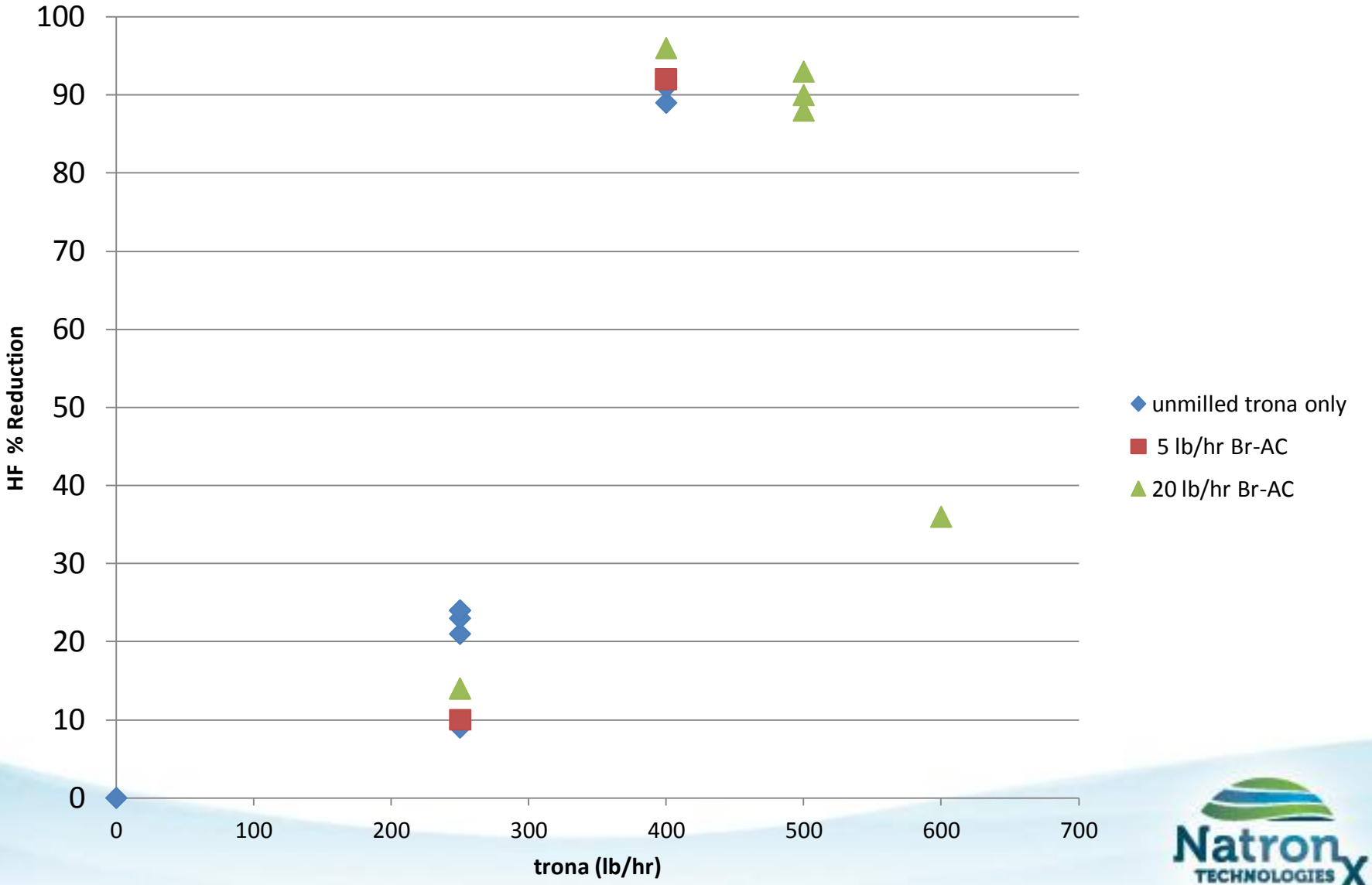
Industrial Boiler Trial - Plant 1



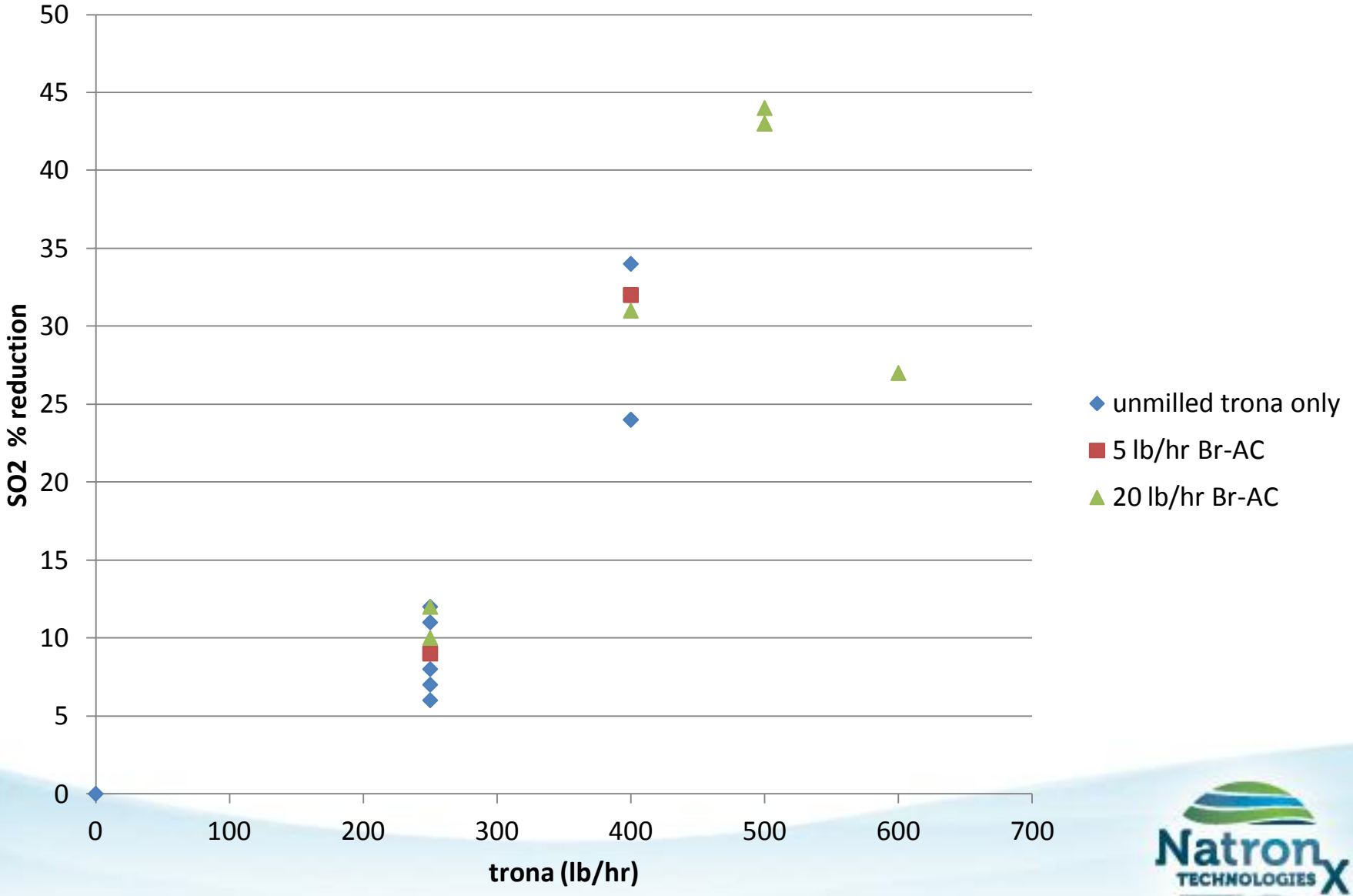
HCl reduction with Trona and Br-AC injection



HF reduction with Trona and Br-AC injection



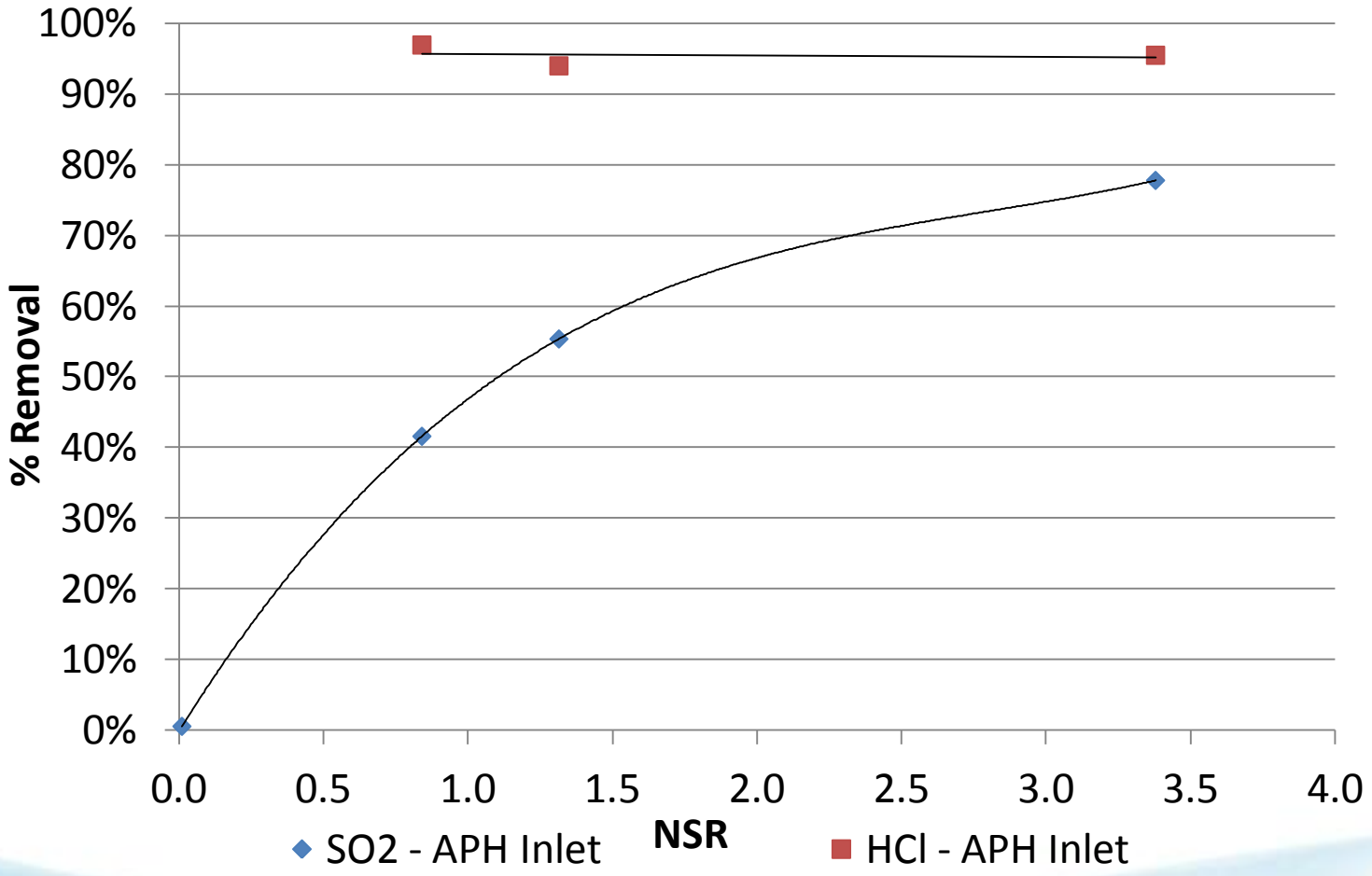
SO_2 reduction with Trona and Br-AC injection



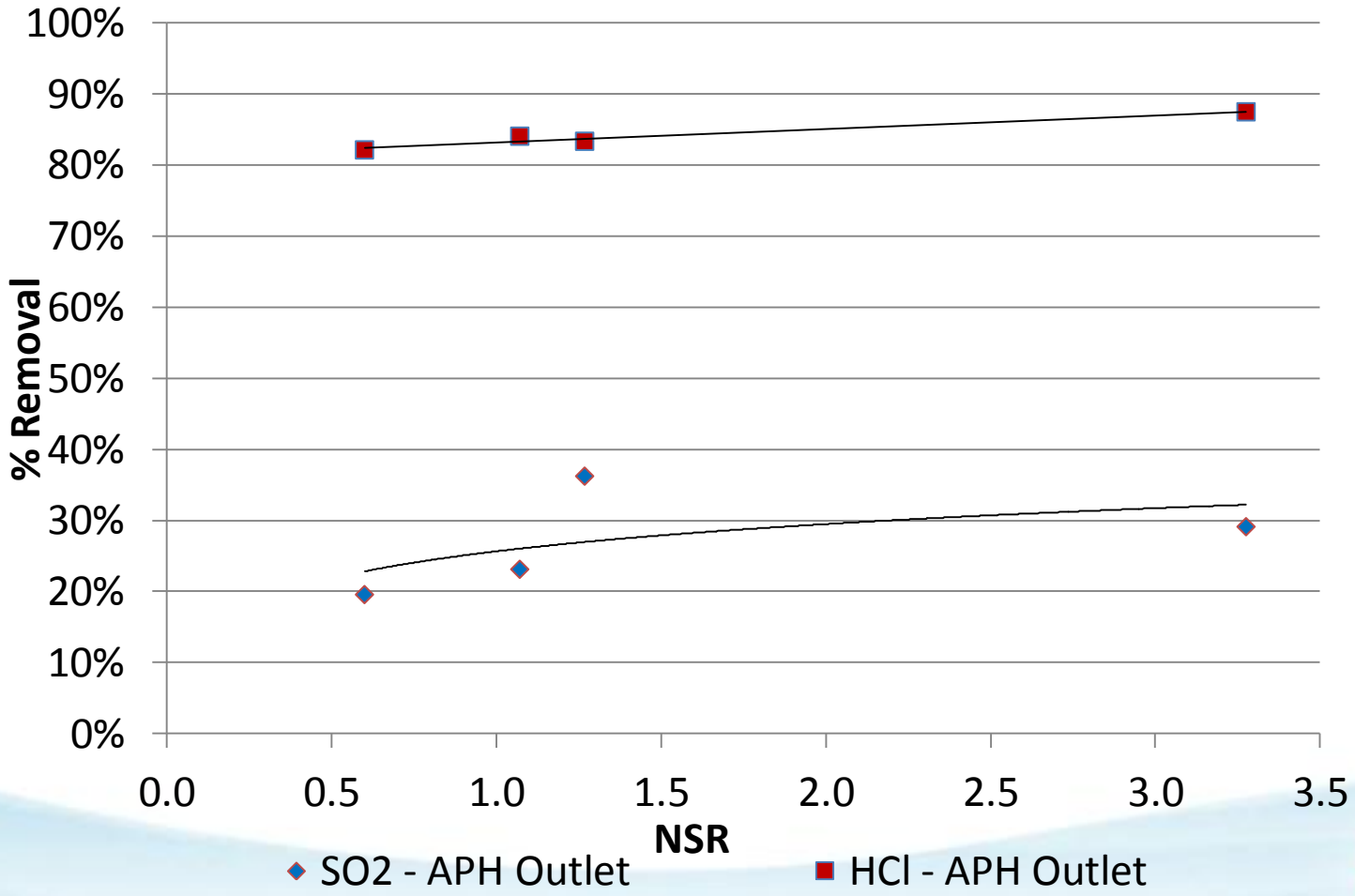
Plant 2 - Utility Boiler Trial

- Size: 240 MW
- Fuel : PRB
- Baseline HCl: 0.001 lb/mmBtu
- Baseline SO_2: 0.46 lb/mmBtu
- Particulate Collector: Cold-ESP
- Injection points
  - APH inlet : 750^o F
  - APH outlet: 300^o F
- Goal: MATS Compliance

HCl & SO_2 Removal Results
Milled Trona Injected at APH Inlet



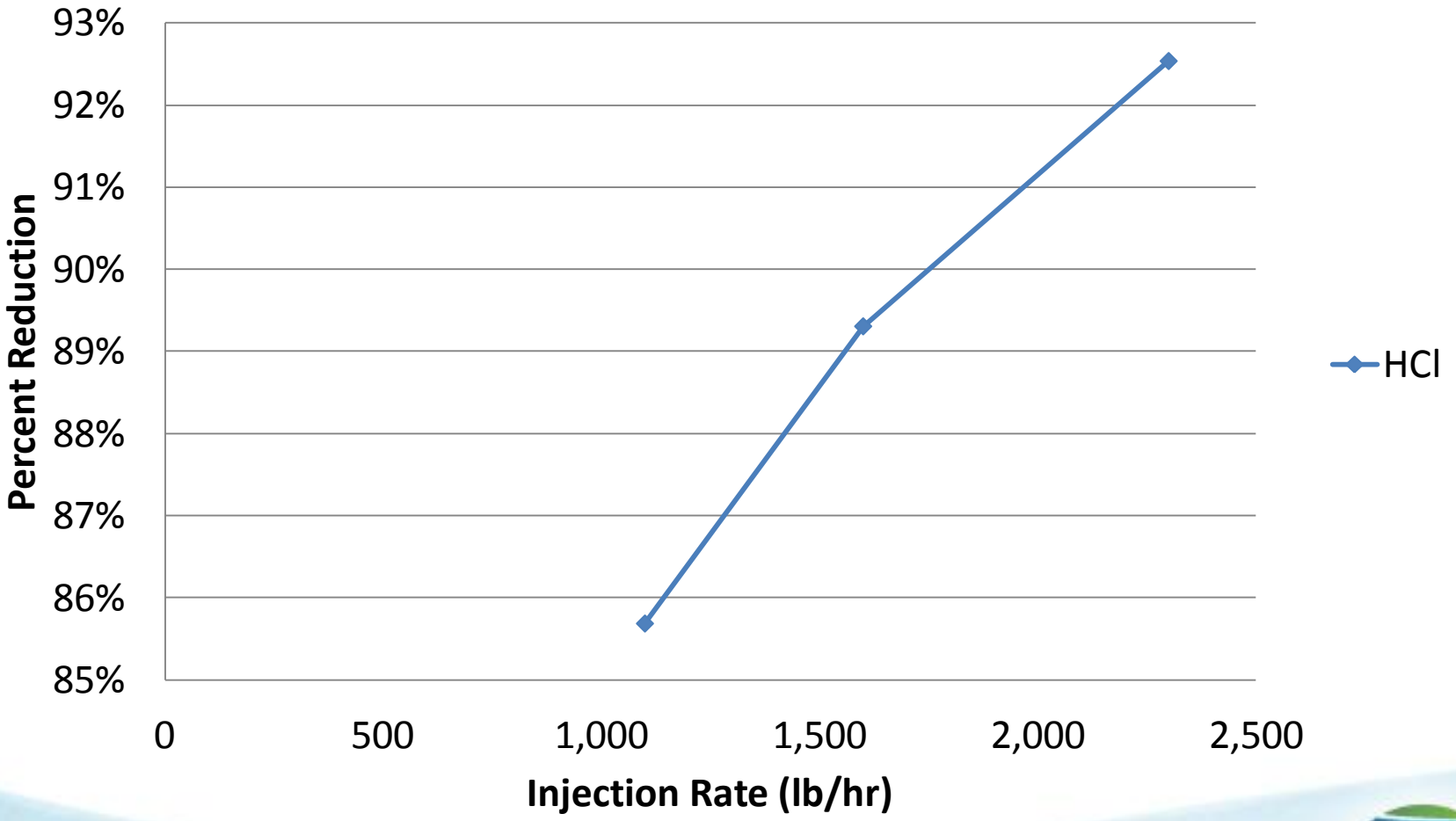
HCl & SO_2 Removal Results
Milled Trona Injected at APH Outlet



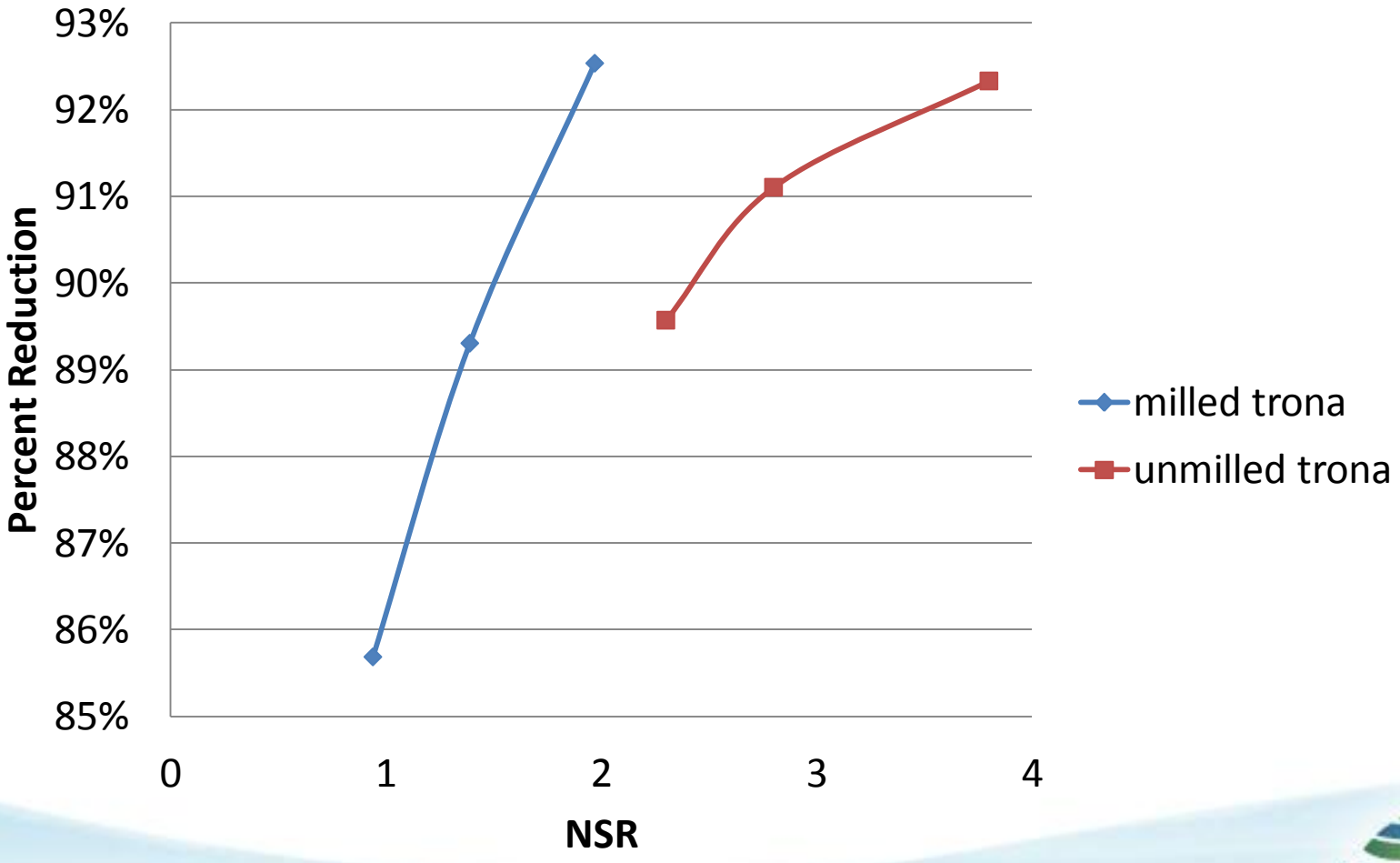
Plant 3 - Utility Boiler Trial

- Size: 90 MW
- Coal Type: PRB
- Baseline SO2: 0.53 lb/mmBtu
- Baseline HCl: 0.005 lb/mmBtu
- Injection point: APH inlet
- Injection temperature: 735^{o} F
- Particulate Collector: ESP

Milled Trona HCl Reduction



Milled vs. Unmilled Trona for HCl reduction



Conclusions

- Dry Sorbent Injection with Trona is an effective solution for industrial and utility boiler emission control strategy.
- Trona has the ability to reduce HCl and HF by 90% or greater
- Temperature does effect the sorbent utilization efficiency
- Milling Trona will reduce the amount of sorbent required to achieve removal targets

Questions

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