Post-Combustion
Dry Reagent Injection
For
Acid Gas Mitigation
Boilers and Cement Kilns

SOUTHERN AIR SOLUTIONS CORP

Clearing the air

Dry Reagent Injection

Discussion

- Trona Basics
- Mobile DRI Systems
- Results
  - 550 MW Utility Boiler
  - 150 kpph Industrial Boiler
  - 950 tpd Cement Kiln

Dry Reagent Injection

<u>Trona</u>

SO_2 Stoic Ratio = 2.35 lb trona/lb SO_2

HCl Stoic Ratio = 2.07 lb trona/lb HCl

$Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$

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Dry Reagent Injection

Normalized Stoichiometric Ratio (NSR)

$$NSR = \frac{\left(\frac{mass\ of\ trona\ injected}{mass\ of\ acid\ gas\ entering\ system}\right)}{\left(\frac{stoichiometric\ mass\ of\ trona}{unit\ mass\ of\ acid\ gas}\right)}$$

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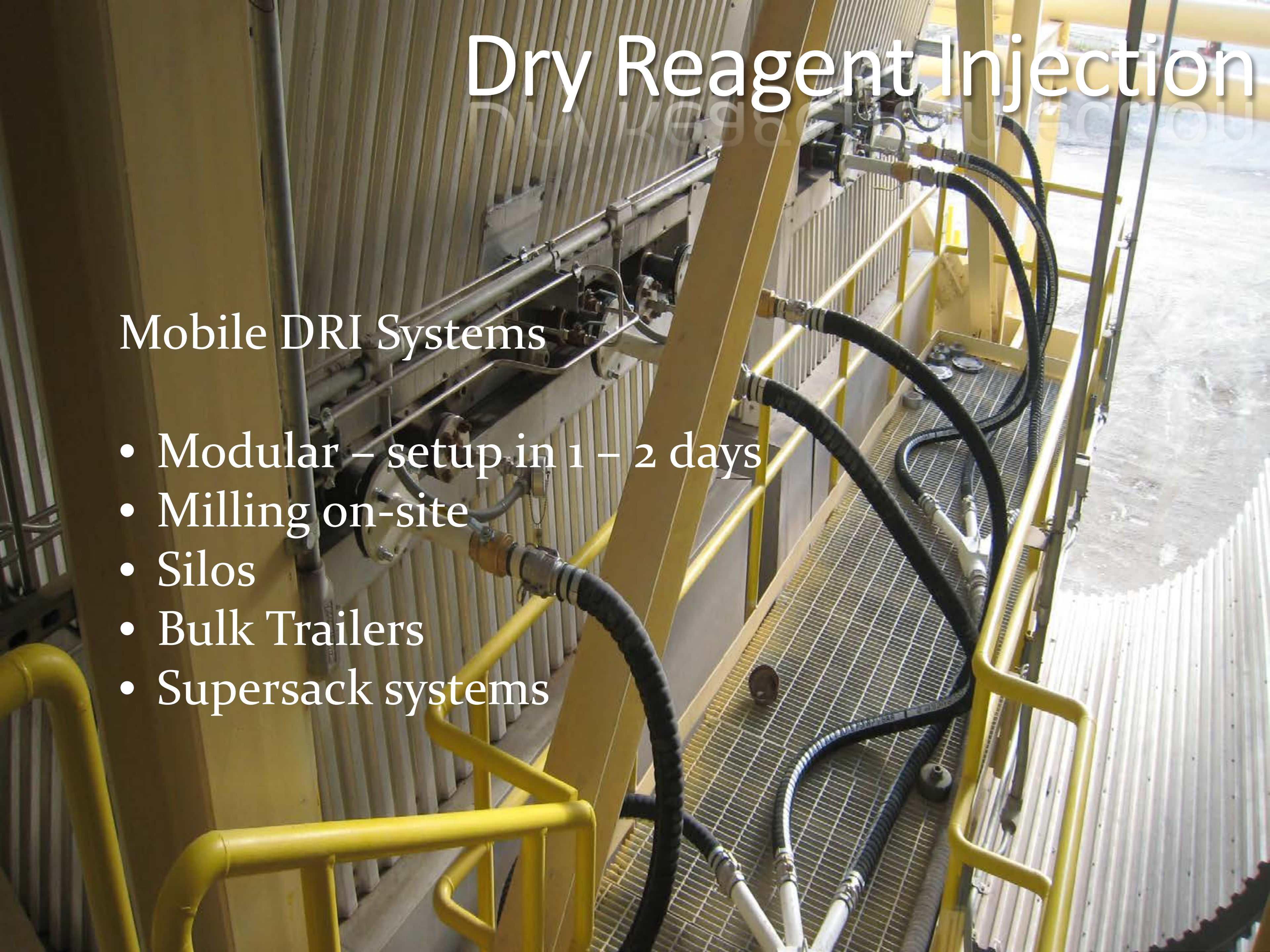
Dry Reagent Injection

Parameters Affecting Acid Gas Removal by DRI

- Sorbent particle size (trona as received – 35 µm D50)
- Sorbent residence time in the flue gas stream
- Sorbent dispersion within the flue gas
- Particulate control device used
- Other acid gases (e.g., high SO_2 concentration)

SO_2 %RE and NSR are functions of these parameters

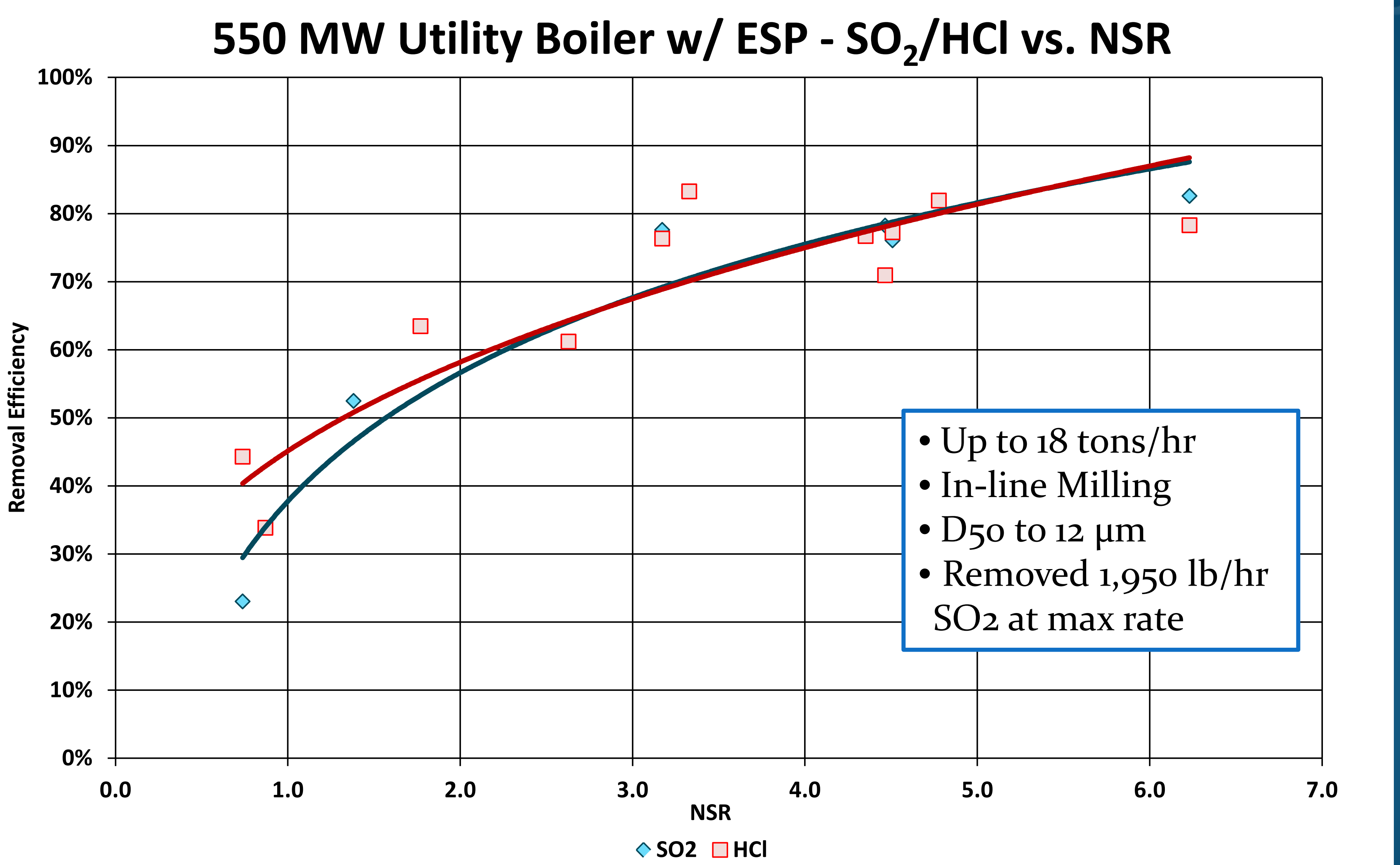
Dry Reagent Injection



Mobile DRI Systems

- Modular – setup in 1 – 2 days
- Milling on-site
- Silos
- Bulk Trailers
- Supersack systems

Dry Reagent Injection



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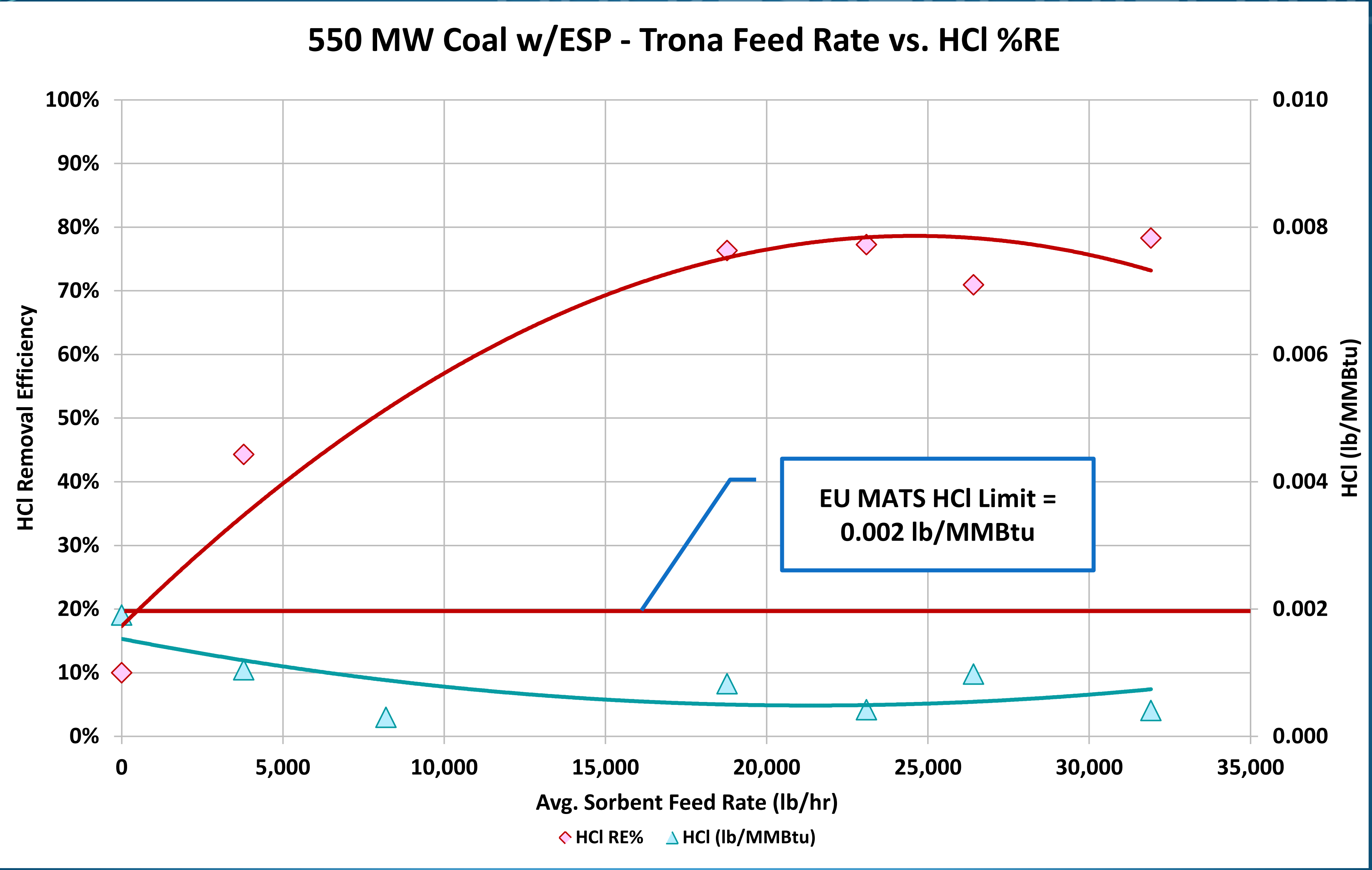
Dry Reagent Injection



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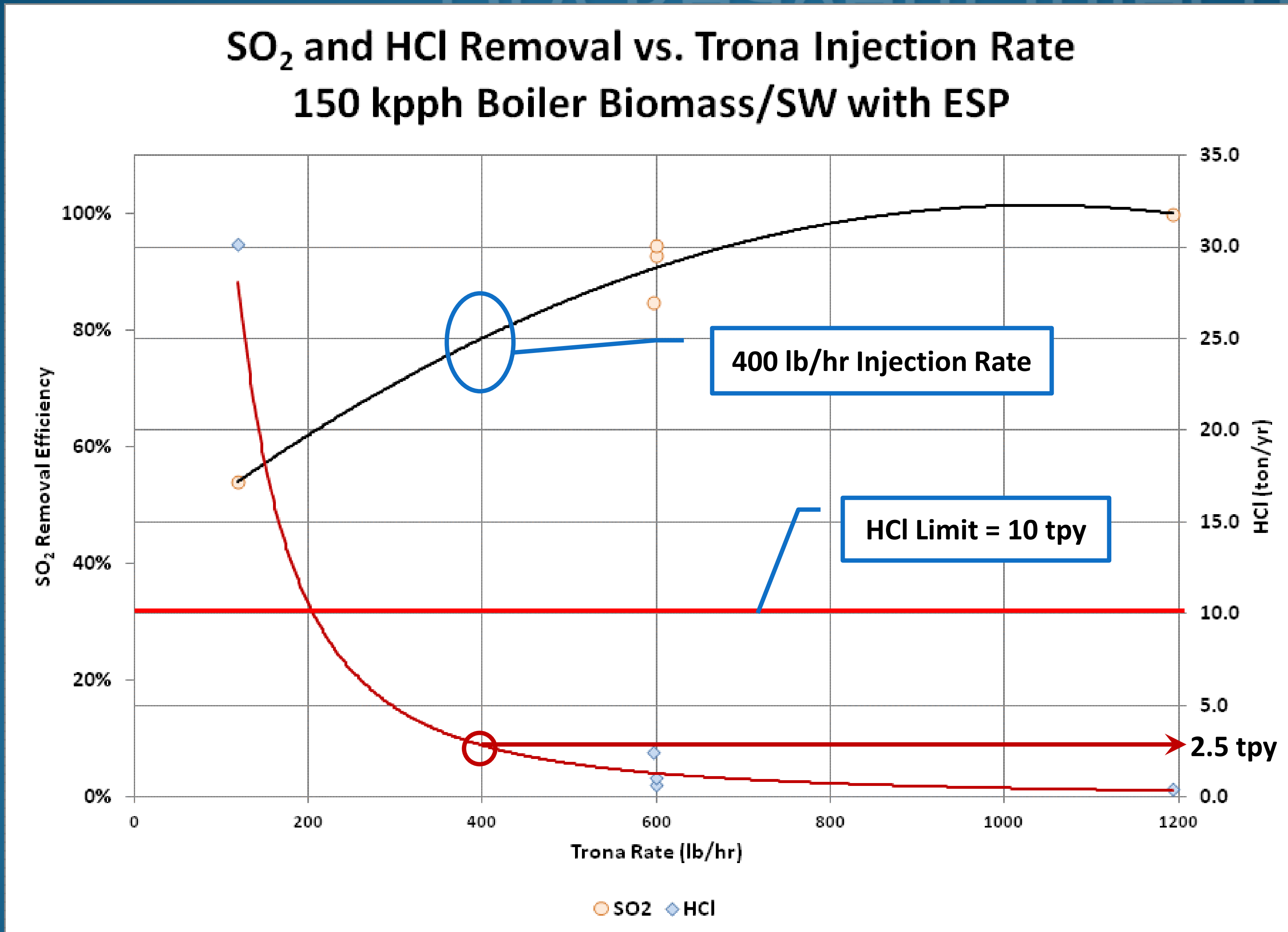
Dry Reagent Injection



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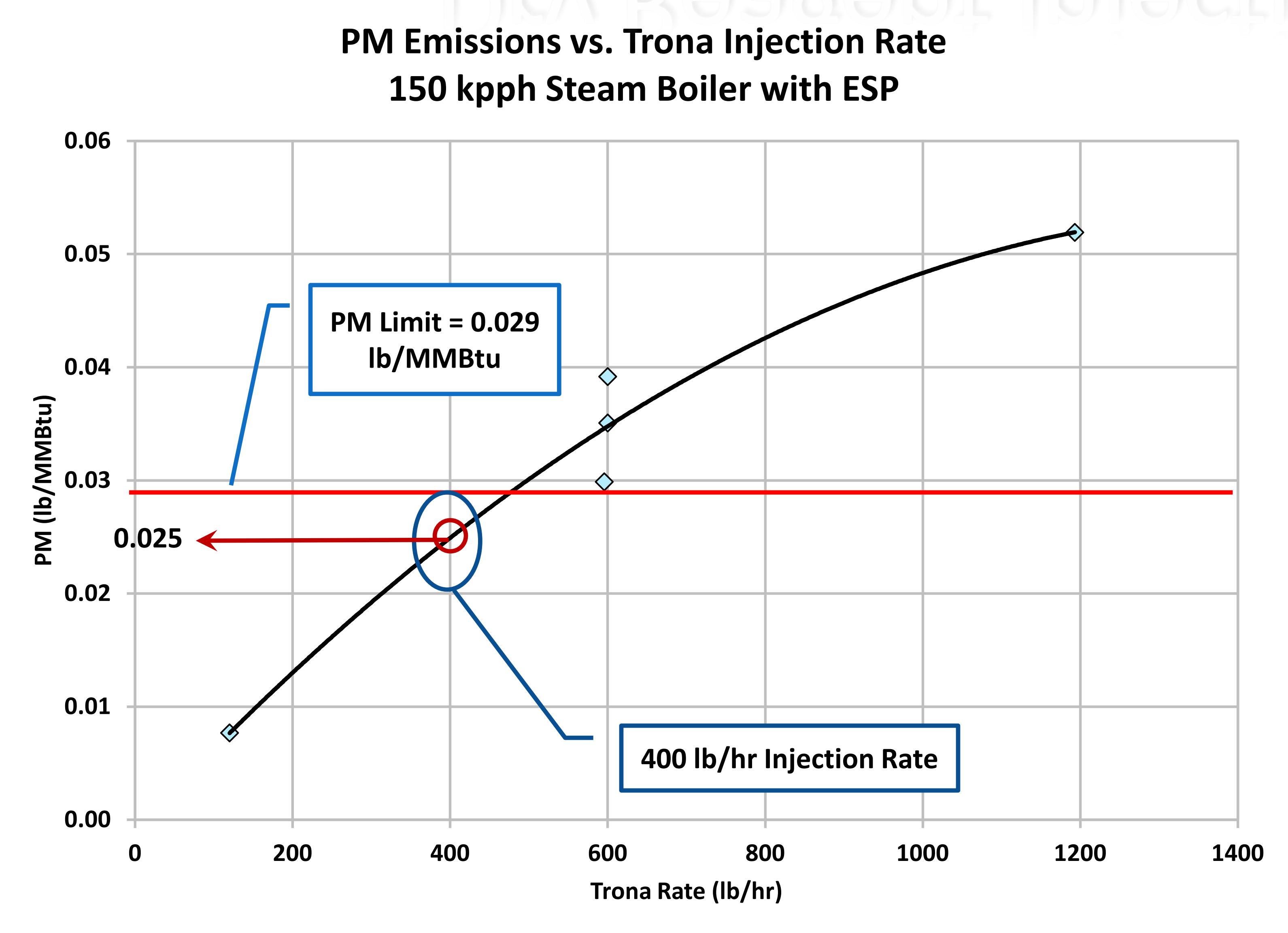

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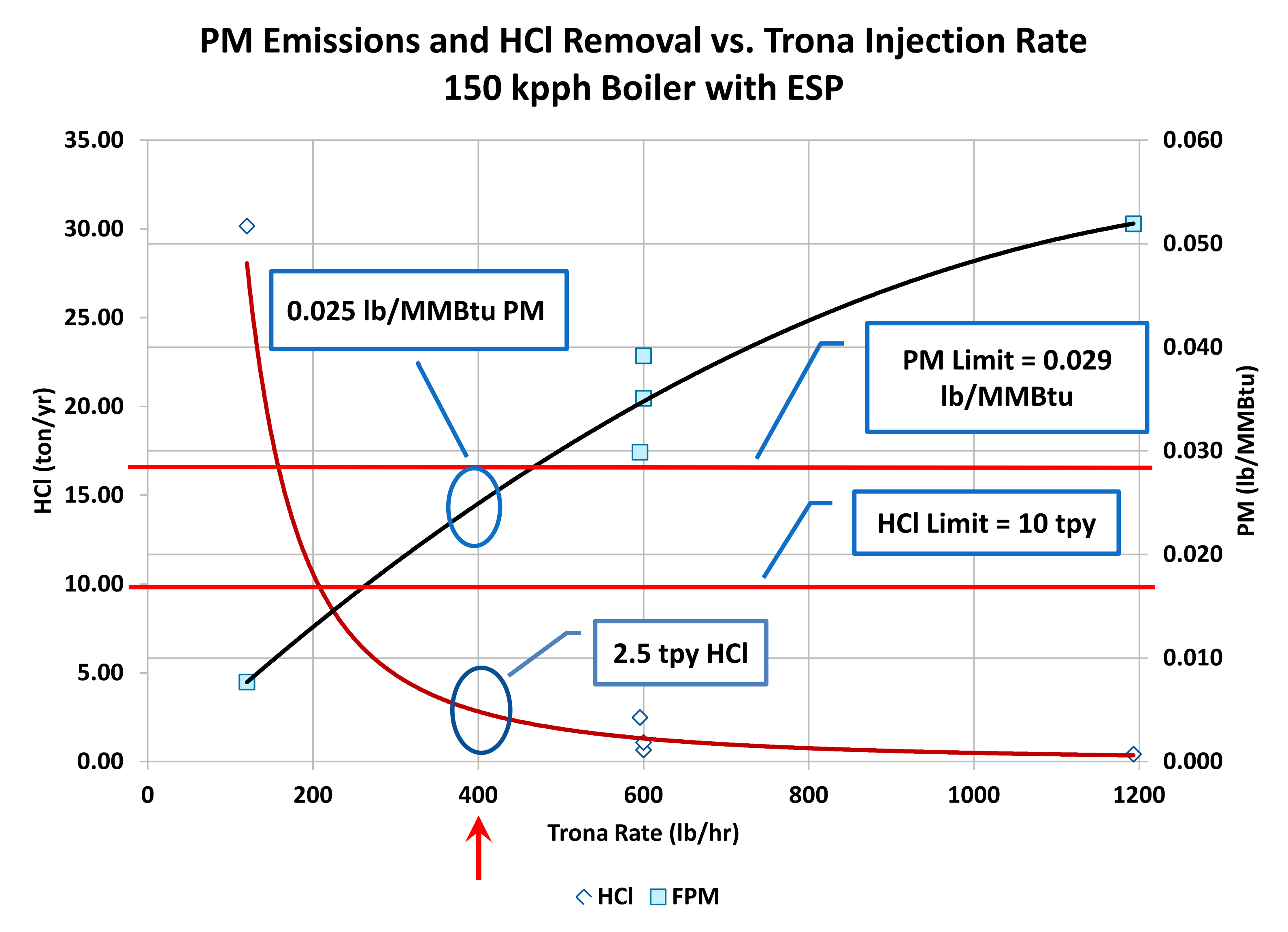

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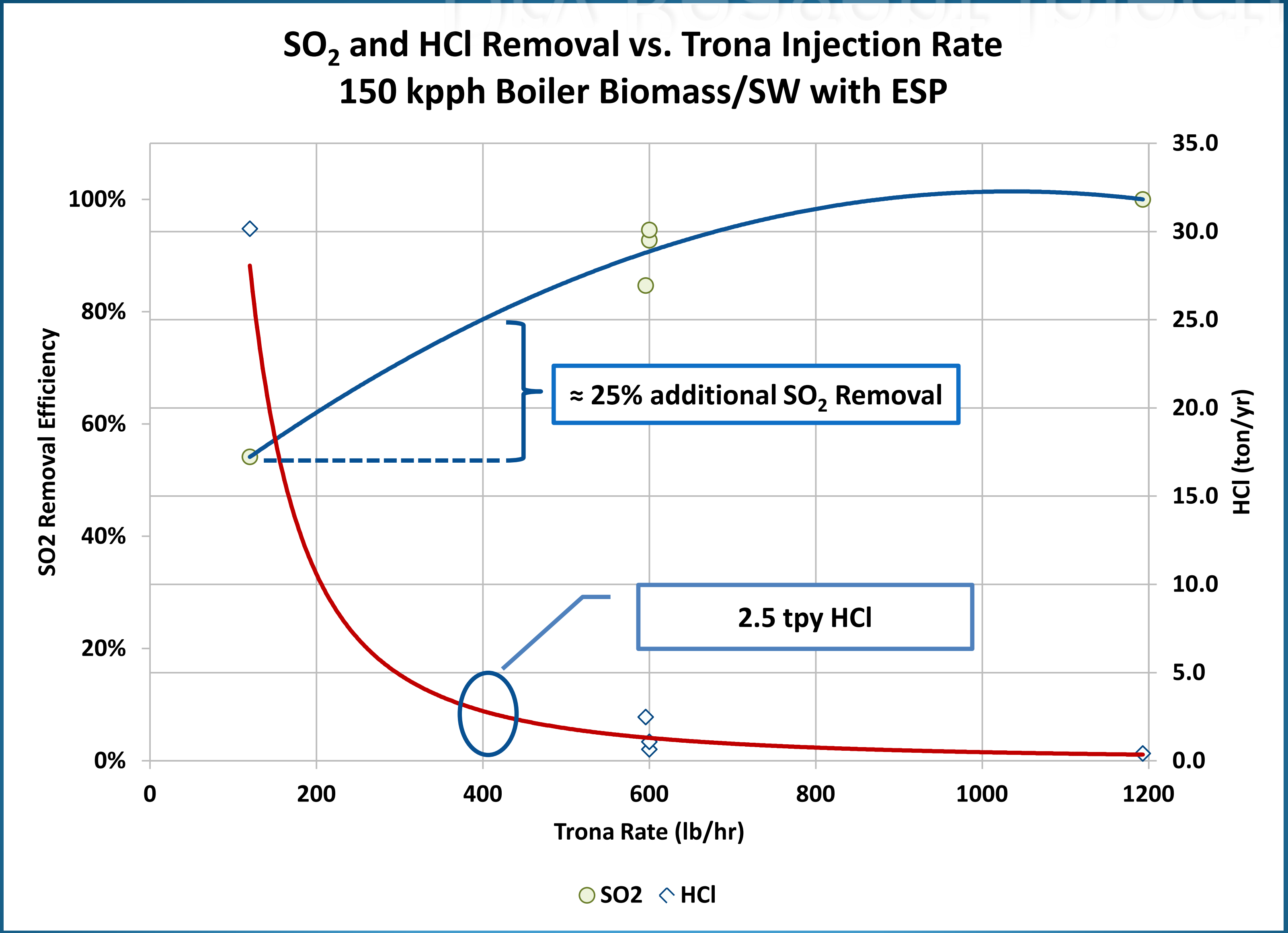
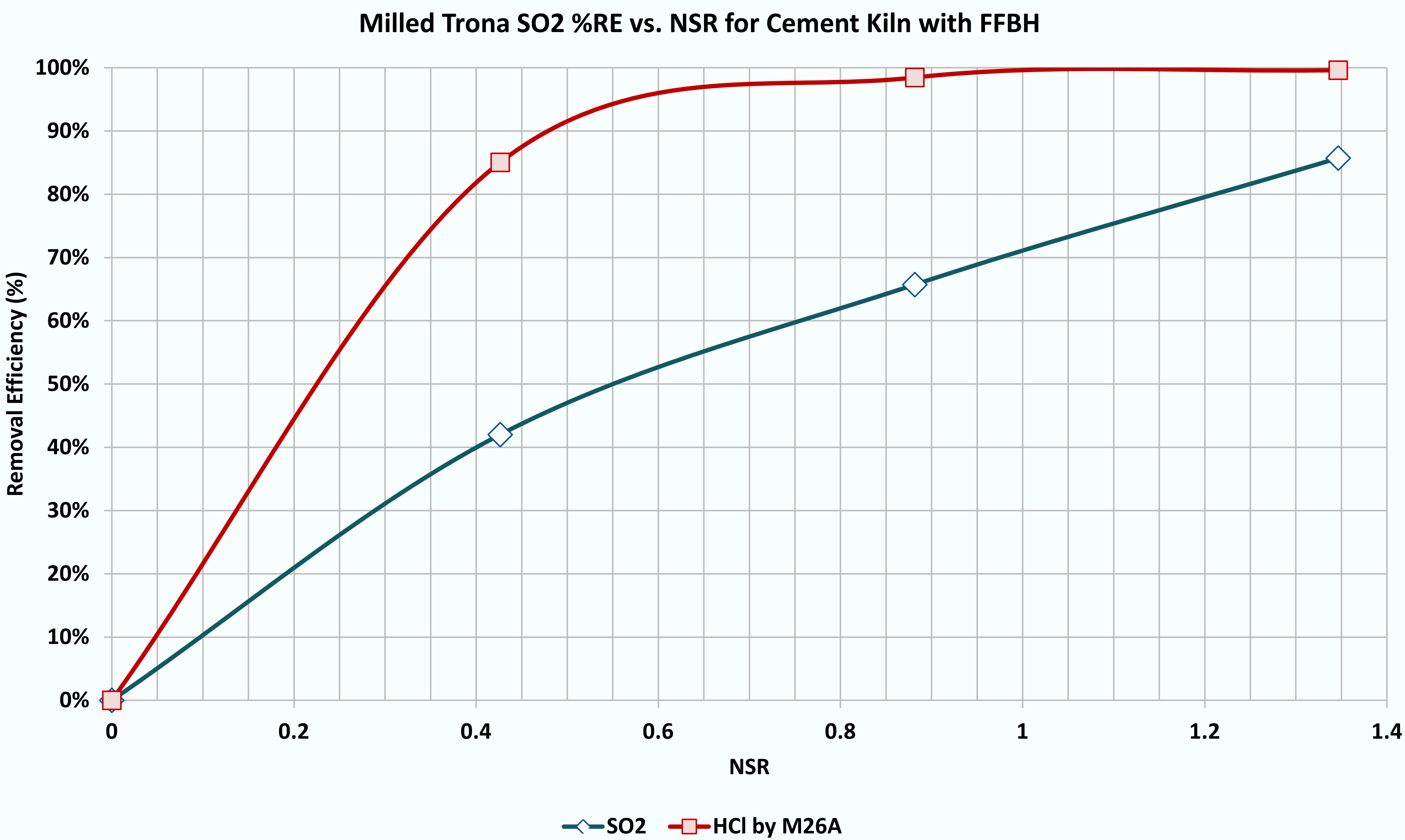


Dry Reagent Injection



Dry Reagent Injection

Operating Unit	Kiln A	Kiln B	Kiln C
Sorbent	Trona	Trona	Trona
APCD	FFBH	FFBH	FFBH
Moisture Content at Stack (%vol)	33.5%	11.5%	16.0%
SO_2 at Stack (ppmvd)	**900**	**110**	**300**
HCl at Stack (ppmvd)	**15**	**15**	**15**
Flue Gas Temperature (F)	350	310	310
Flue Gas Flow Rate (acfm)	160,000	220,000	150,000
Flue Gas Flow Rate (scfm)	104,691	151,429	103,247
Flue Gas Flow Rate (dscfm)	69,620	134,014	86,727
Clinker Produced (ton/day)	**950**	**1,100**	**1,900**
CKD Collection Rate (ton/hr)	**5.0**	**3.5**	**6.0**
CKD Recycled (%)	**40%**	**100%**	**100%**
SO_2 (lb/hr)	625.0	147.0	259.5
HCl (lb/hr)	5.93	11.42	12.32
HCl (ppmvd @ 7% O2)	**14.0**	**14.0**	**23.3**
HCl - %RE required to Comply with PC MACT	**79%**	**79%**	**87%**

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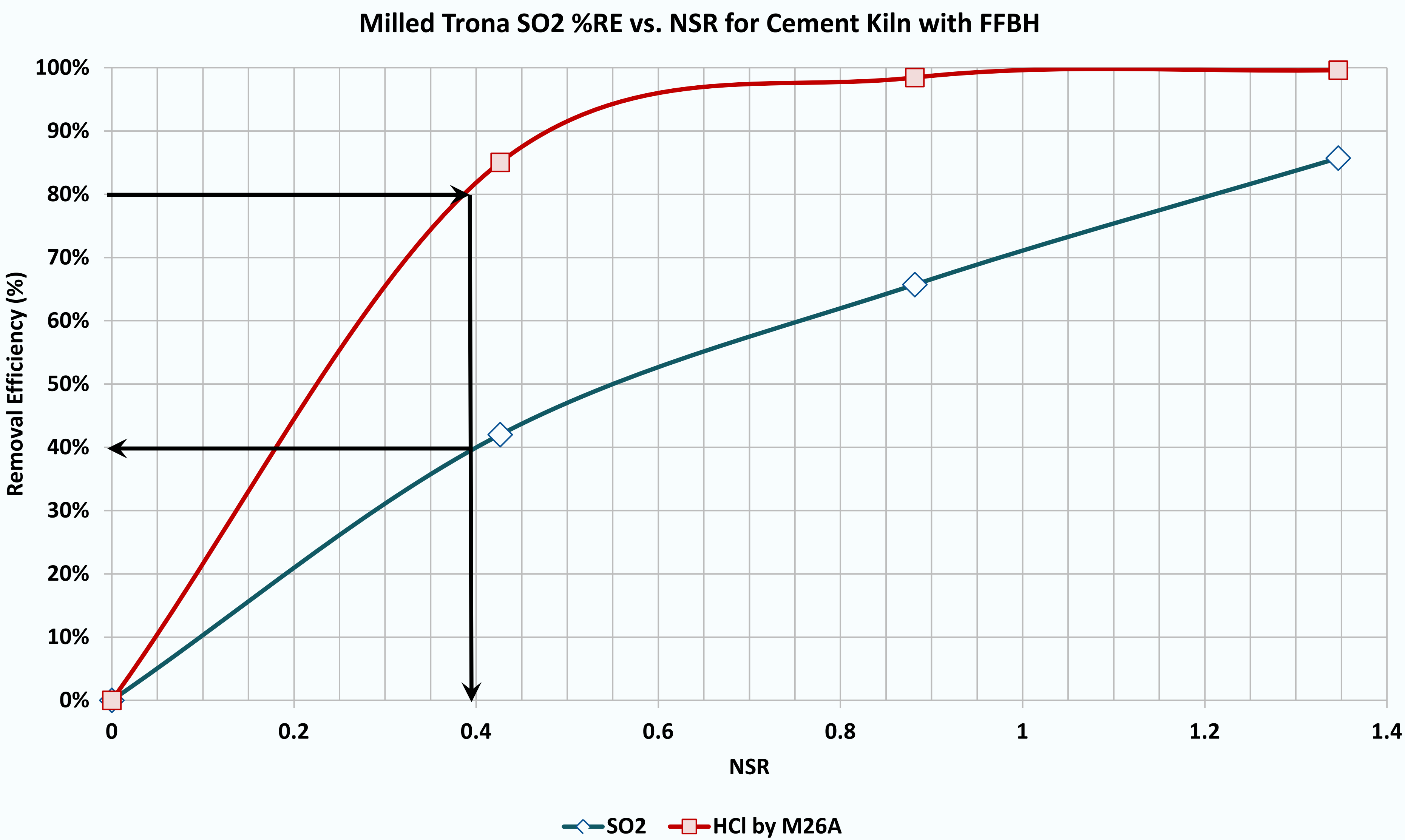

Dry Reagent Injection

Operating Unit	Kiln A	Kiln B	Kiln C
SO_2 NSR Required	0.45	0.45	0.45
SO_2 - Corresponding %RE	40%	40%	40%
TOTAL TRONA NEEDED (lb/hr)	**672**	**176**	**297**
Clinker Production (lb/hr)	79,167	91,667	158,333
CKD Recycled (%)	40%	100%	100%
CKD Rate Recycled (lb/hr)	4,000	7,000	12,000
Na_2SO_4 Formed (lb/hr)	555	130	230
NaCl Formed (lb/hr)	10	18	20
Na from Trona Into CKD (lb/hr)	82	54	91
Na Recycled to Kiln (lb/hr)	33	54	91
Na In Clinker from Trona (%wt)	**0.041%**	**0.059%**	**0.057%**
Na_2O Equivalent in Clinker from Trona (%wt)	0.056%	0.079%	0.077%

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Considerations

- Failed fly ash TCLP for selenium
  - High Se bearing coal
  - High trona injection rates
- Greatly reduced trona usage with baghouse
- Plume coloration at high trona injection rates (NO_2)
- Can boost native Hg removal
- Can increase Hg emissions
- Inorganic CPM emissions increase (CPM expected to be regulated from EU boilers as $PM_{2.5}$)
- Land-filling considerations

Conclusions

- Trona has high reactivity with HCl and SOx compounds
- Greatly reduced trona usage with baghouse and milling
- Trona can be a solution for EU MATS and Boiler MACT for HCl
- For moderate to low SO_2 flue gases trona may be a solution for PC MACT compliance for kilns recirculating up to 100% of CKD
- For high SO_2 flue gases trona may be a solution but may require wasting more CKD

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