

Attachment C

Boiler Retirement – Something New to Consider

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EnerChem Incorporated

Louisville, KY August 15, 2012

An aerial photograph of a large industrial facility, likely a power plant, featuring several large cooling towers emitting white steam and a tall smokestack. The plant is situated in a green, rural landscape with a road and some buildings visible in the distance.

BOILER RETIREMENT: CLEARCHEM IS SOMETHING NEW TO CONSIDER

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What is ClearChem (TM)?

- Furnace sorbent injection process
- Patented, based on micronized reagents, CaCO_3 , $\text{CA}(\text{OH})_2$, fly ash and industrial byproducts as powders or high solids dispersions
- Small footprint – simple Hardware
- Very low cost



What are ClearChem effects?

- Effective scavenging of SO_2 , SO_3 , and HCL
- High surface for capture of oxidized Hg
- Minimal tube deposits and impact on ESP
- Marketable dry ash – no pond leaching
- Allows lower exit gas temps and benefits



ClearChem Is New FSI Technology

- Decades old attempts at furnace sorbent injection (FSI) showed mixed results at best
 - ClearChem is different – it solves past issues to release the promise of FSI:
 - Sub micron reagent particles avoid deposits
 - Computer Modeling assures proper distribution
 - Burner zone injection for longer reaction time
 - Better reagent utilization avoids ESP issues
-



ClearChem Versus Old FSI

ClearChem	Old FSI
70-84% SO ₂ captured	30-50% SO ₂ captured
Less than 2 Ca/S	More than 2 Ca/S
Normal soot blowing	Continuous soot blowing
Modest increase in ESP ash burden	Massive increase in ESP ash burden



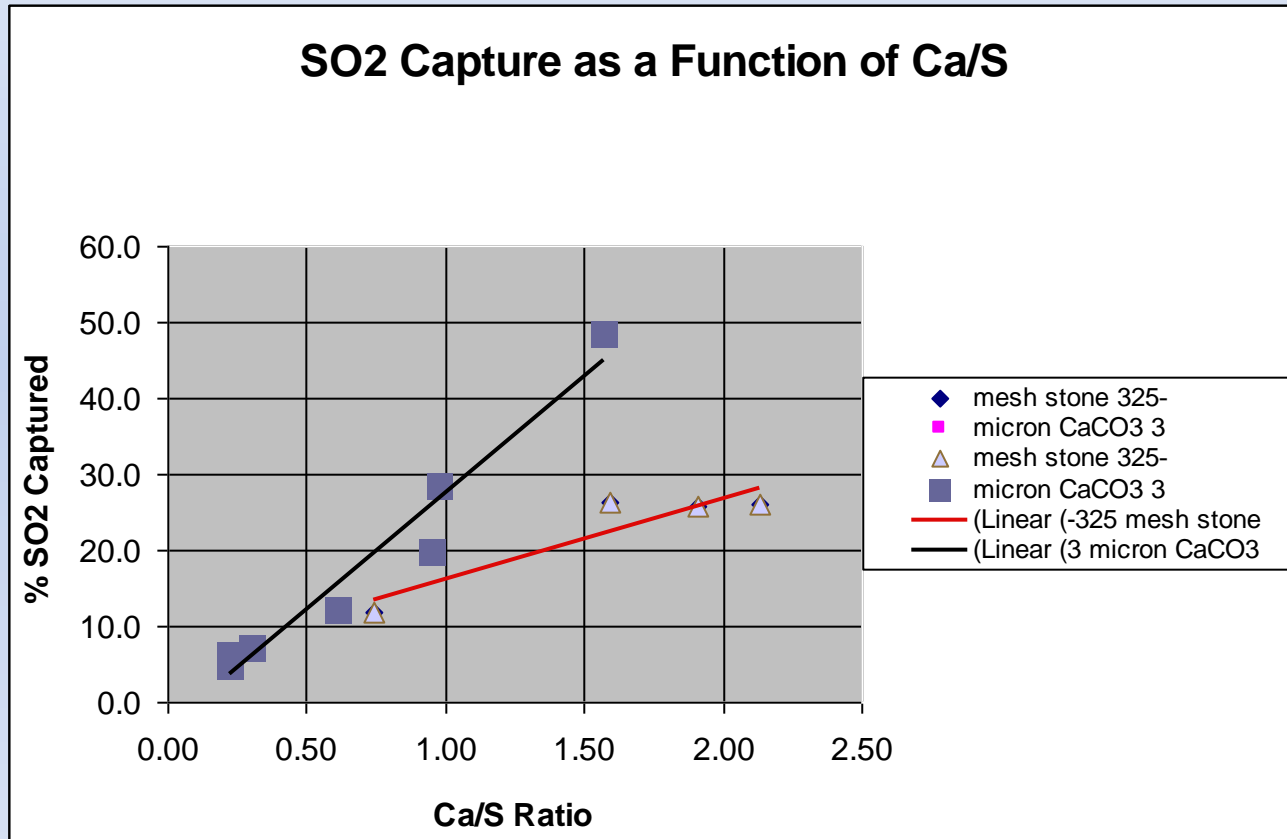
Results of Pilot and 3 Short Boiler Trials

- 84% SO₂ capture at Ca/S =1.9
 - Lower exit temp will boost capture
- HCl capture circa 75%
- SO₃ virtually all captured
 - Allows lower exit gas temp, heat rate, CO₂ release

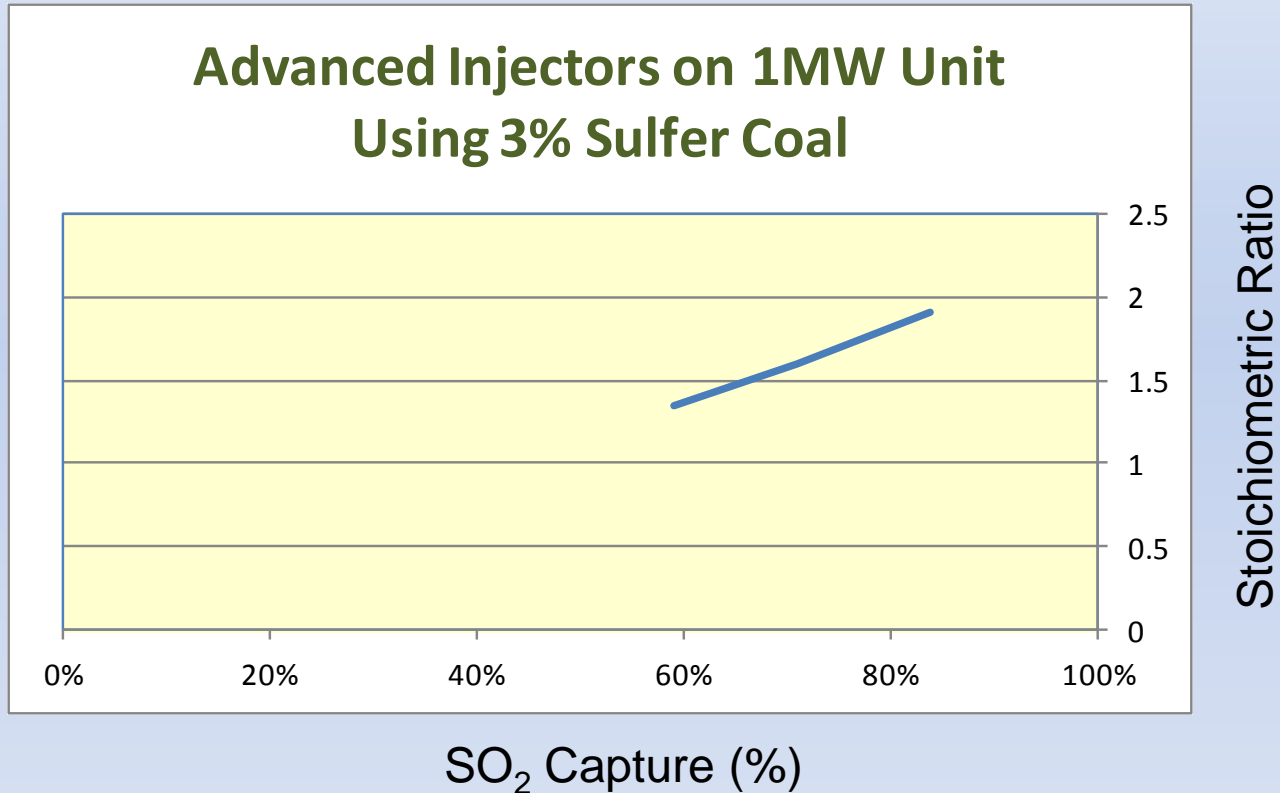


65 MW Coal Fired Utility boiler

3 micron vs. – 325 mesh powders



Results of Advanced Injector Tests



Why is ClearChem More effective?

- Surface Area of 0.5 micron reagent is mostly external and 88 times that of 325 mesh
- Number of particles per lb of 0.5 micron reagent is 676,000 times that of 325 mesh
- Result: The probability of a reagent particle finding the scarce pollutant molecules in the huge volumes of flue gas is much greater



Costs and Benefits

- Capital cost: starting under \$500,000/unit
- Operating cost: \$400 – 600/ton SO₂ mitigated
- Safe, widely available, easily handled reagents



Additional Benefits

- Can make existing FGD more effective
- SO₃ removal eases oxidized Hg capture
- Existing CaCO₃ supply can be used
- Improves economics of flue gas H₂O recovery
 - nearly ton/ton coal – more on scrubbed units

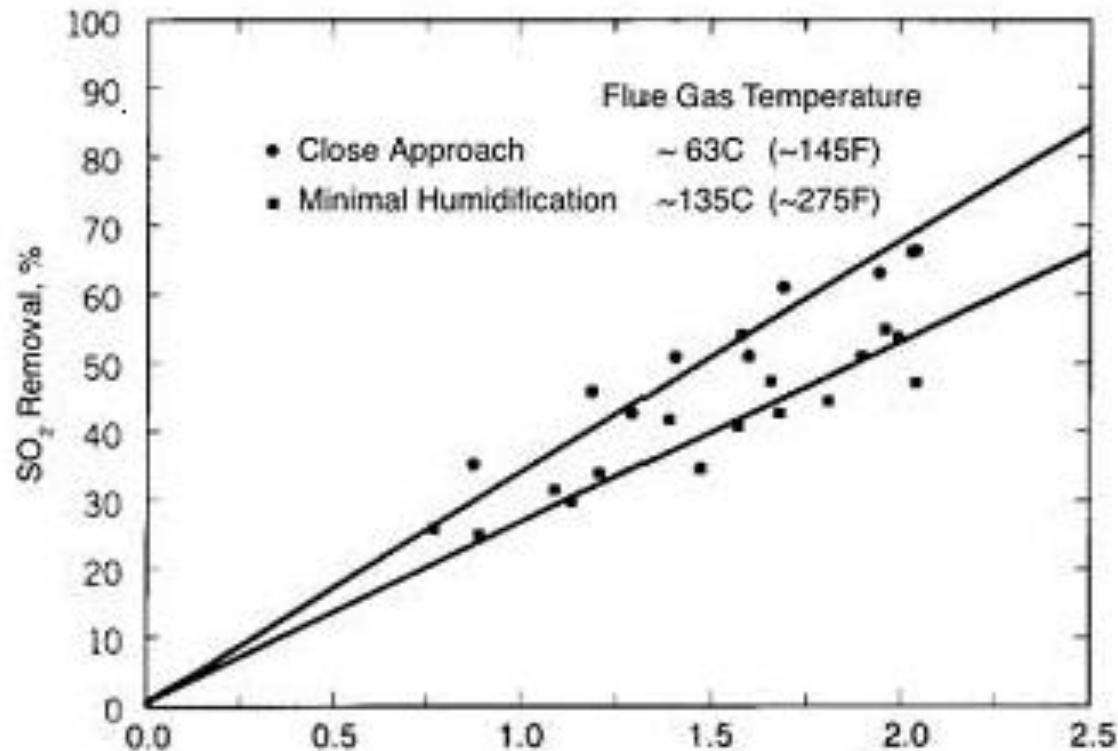


Costs Can Be Reduced Further

- By capitalizing on SO₃ capture to lower flue gas temp – (investment required)
 - Improve unit heat rate – reduce CO₂ emission
 - Recover water from flue gas
- By enhancing reagent capture efficiency via
 - Lowering flue gas temperature - proven
 - Improving injector performance - projected
 - Utilizing byproduct or waste reagent – projected



EFFECT OF FLUE GAS COOLING ON SO₂ CAPTURE



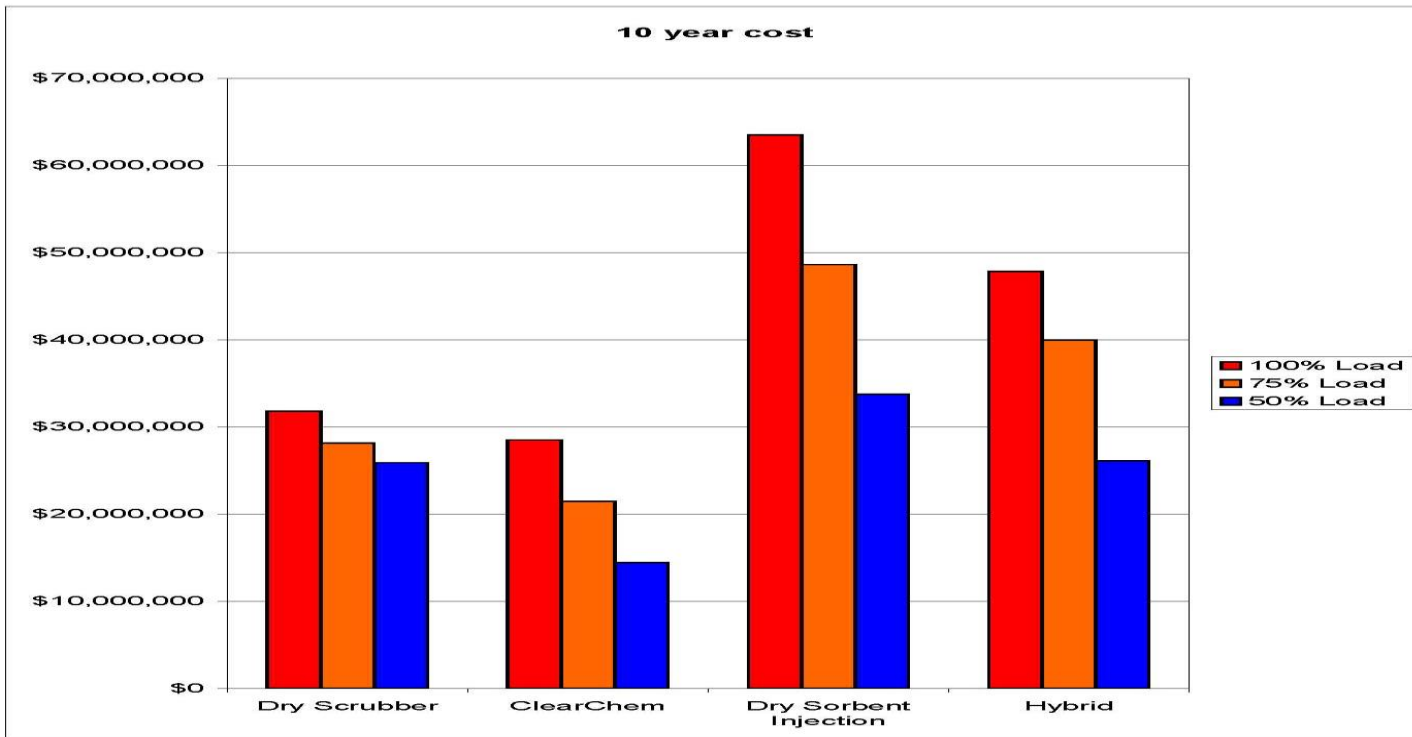
***DOE Boiler Trials
Using 325 Mesh
Limestone Powder***

Best Fit Solution

- ClearChem is the optimal solution for plants seeking to control costs associated with emissions control
 - Lower exit temps to enhance pollutant capture
 - Use less costly construction materials
 - Facilitate smaller less costly hardware
 - Makes DSI more cost effective
 - Maintains ash marketability – avoid pond leach



Comparative Cost Over Time



ClearChem vs. DSI

	ClearChem	DSI
SO ₂ Capture	70-84%	30-80%
Stoichiometric Ratio	Under 2	Over 2
Lbs/lbs SO ₂	3.13	4.82
Application	dispersions	powder
Application Point	burner/nose	econ/ESP
Install Time	3-6 months	6-9 months
Costs, Capital	\$400,000	\$4,000,000
Reagent	\$435-\$802/ton less SO ₂	\$1020-\$1632/ton less SO ₂



ClearChem vs. DSI

	ClearChem	DSI
Ash marketable	Yes	Yes/No
ESP impact	No (3 demos)	Yes/No
Reagent supply	Mostly local	More remote
Reagent handling	Easy	More labor
Safety & corrosion	No	Yes
Landfill leaching	No	Yes/No
Furnace deposits	Minor	None



Company Status

- US Patents received and pending
- Three short (1 to 2 weeks) boiler trials completed
- First licensing agreements complete for reagent and applicator partners
- Preparing for large scale demonstration under utility operating conditions (1st half 2013)
- International patents pending
- Extending licensing partnerships to additional geographies
- Preparing an equity raise of \$3-5 million





CFD modeling indicates best injection sites (2 nozzles at each of the OFA and Side Door ports). Above shows the pump skids and day tank.



Conclusions

- ClearChem has the potential to lower emission control costs across the board
 - Costs low enough to compete with retirement
 - Less expensive way to upgrade FGD systems
 - Reduce DSI operating costs
 - Practical way to control SO₃ & reap benefits
 - Reduce fuel consumption and CO₂ emissions
 - Recover H₂O from flue gas
 - Eliminate “blue plume”

