Boiler Retirement – Something New to Consider

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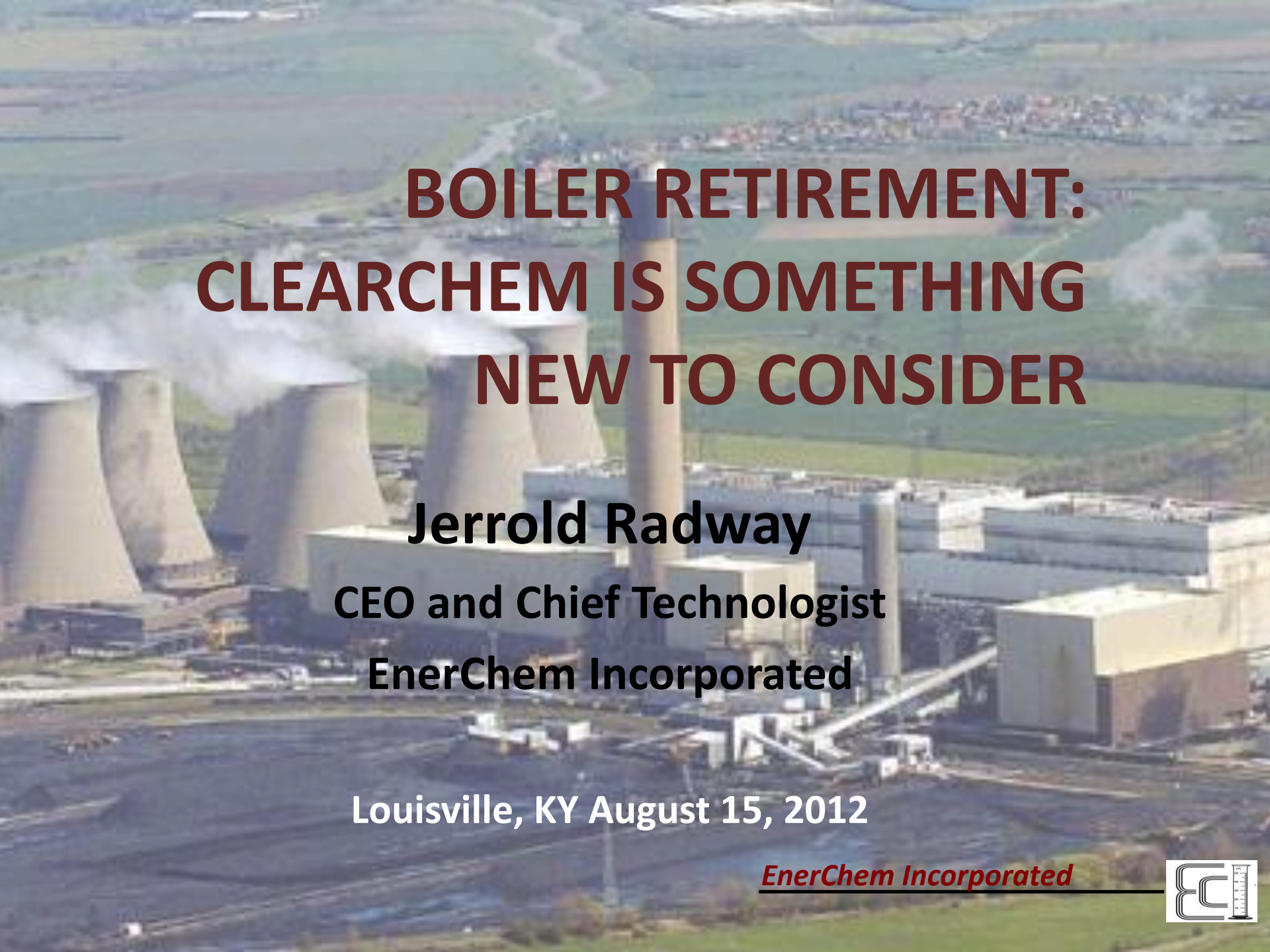
Louisville, KY August 15, 2012



BOILER RETIREMENT: CLEARCHEM IS SOMETHING NEW TO CONSIDER

Jerrold Radway

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EnerChem Incorporated

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What is ClearChem (TM)?

- Furnace sorbent injection process
- Patented, based on micronized reagents, $CaCO_3$, $CA(OH)_2$, 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

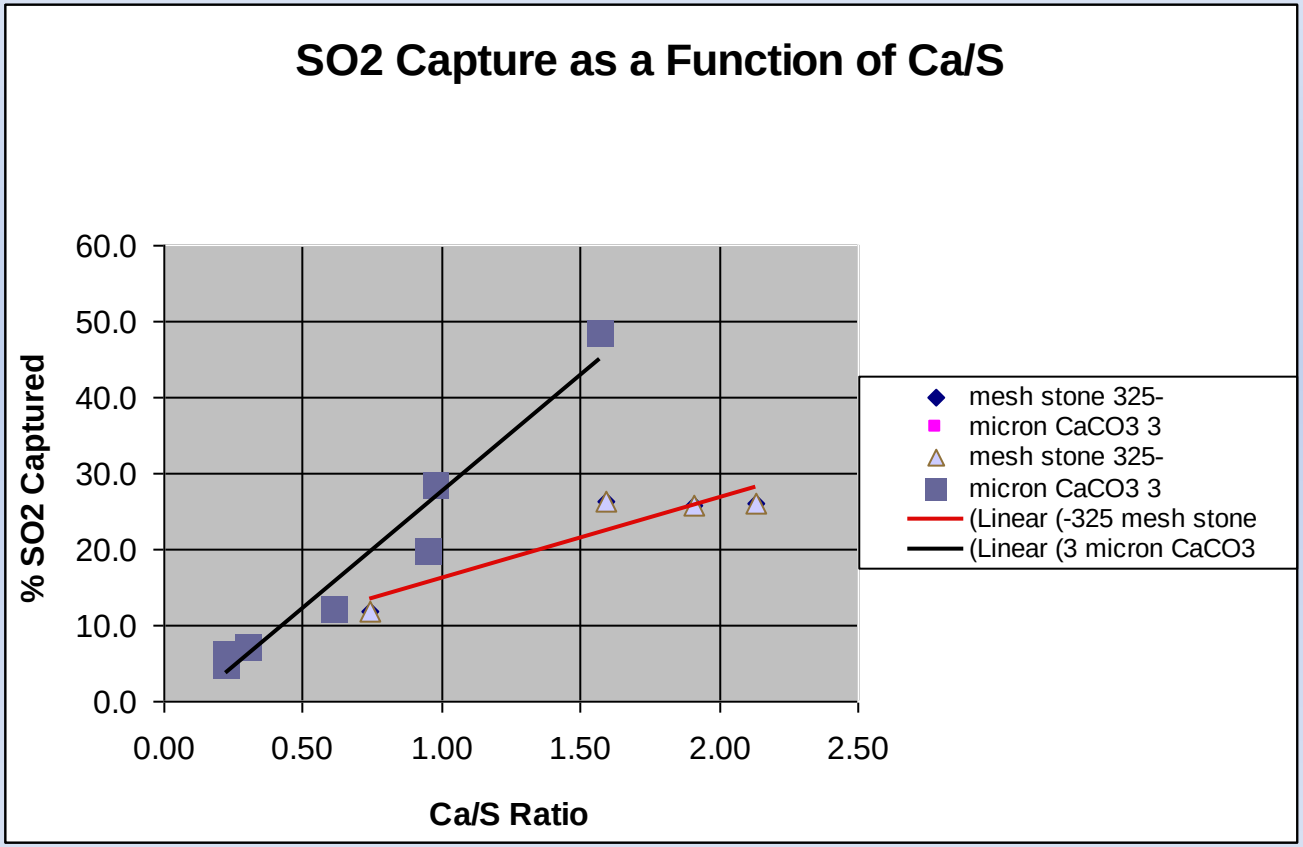
ClearChem	Old FSI
70-84% SO_2 captured	30-50% SO_2 captured
Less than 2 Ca/S	More than 2 Ca/S
Normal soot blowing	Continuous soot blowing
Modest increase in ESP ash burden	Massive increase in ESP ash burden

Results of Pilot and 3 Short Boiler Trials

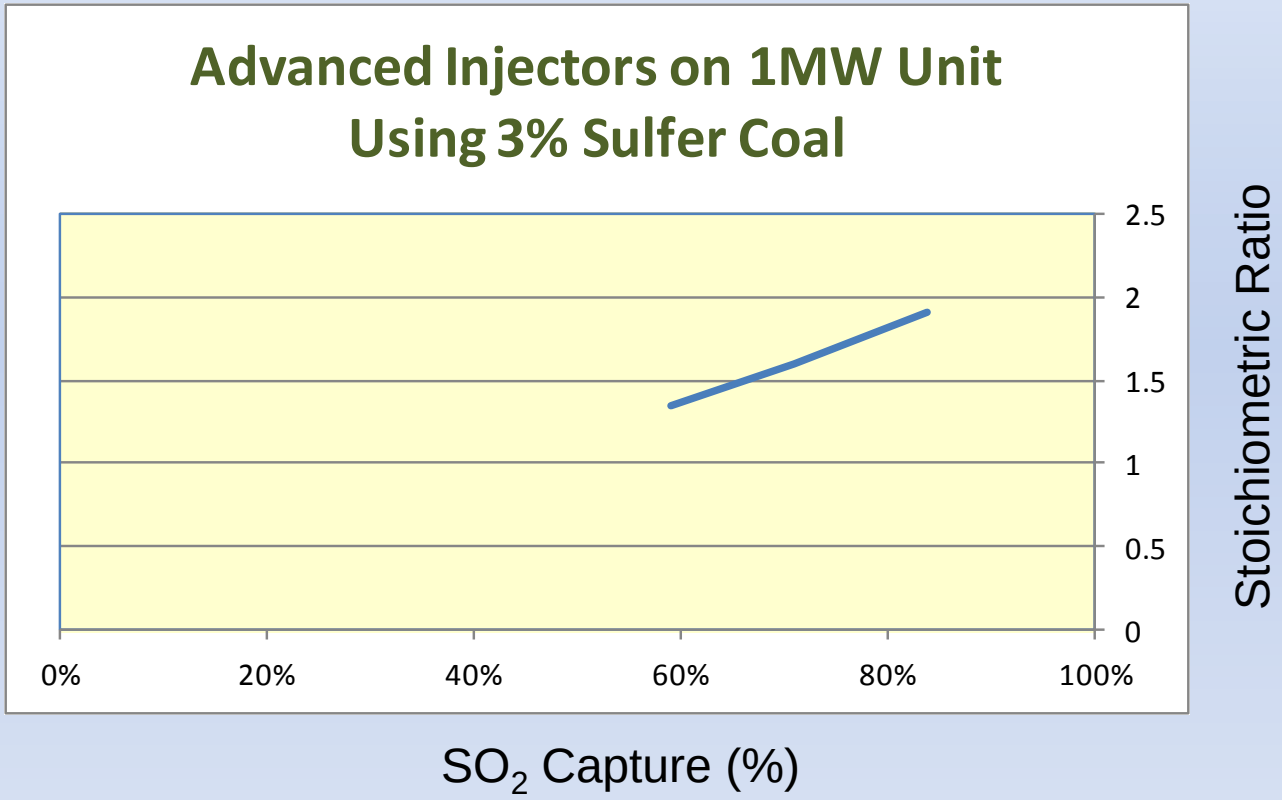
- 84% SO_2 capture at Ca/S =1.9
  - Lower exit temp will boost capture
- HCl capture circa 75%
- SO_3 virtually all captured
  - Allows lower exit gas temp, heat rate, CO_2 release

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 SO_2 mitigated
- Safe, widely available, easily handled reagents

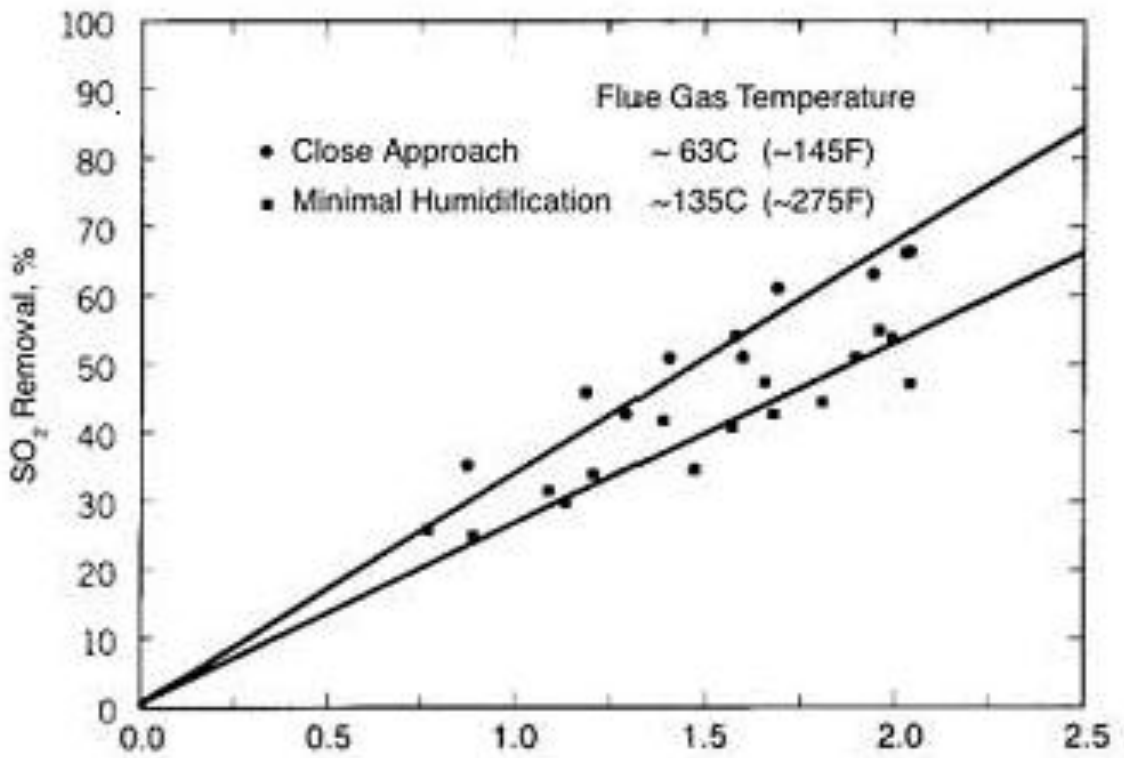
Additional Benefits

- Can make existing FGD more effective
- SO_3 removal eases oxidized Hg capture
- Existing $CaCO_3$ supply can be used
- Improves economics of flue gas H_2O recovery – nearly ton/ton coal – more on scrubbed units

Costs Can Be Reduced Further

- By capitalizing on SO_3 capture to lower flue gas temp – (investment required)
  - Improve unit heat rate – reduce CO_2 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



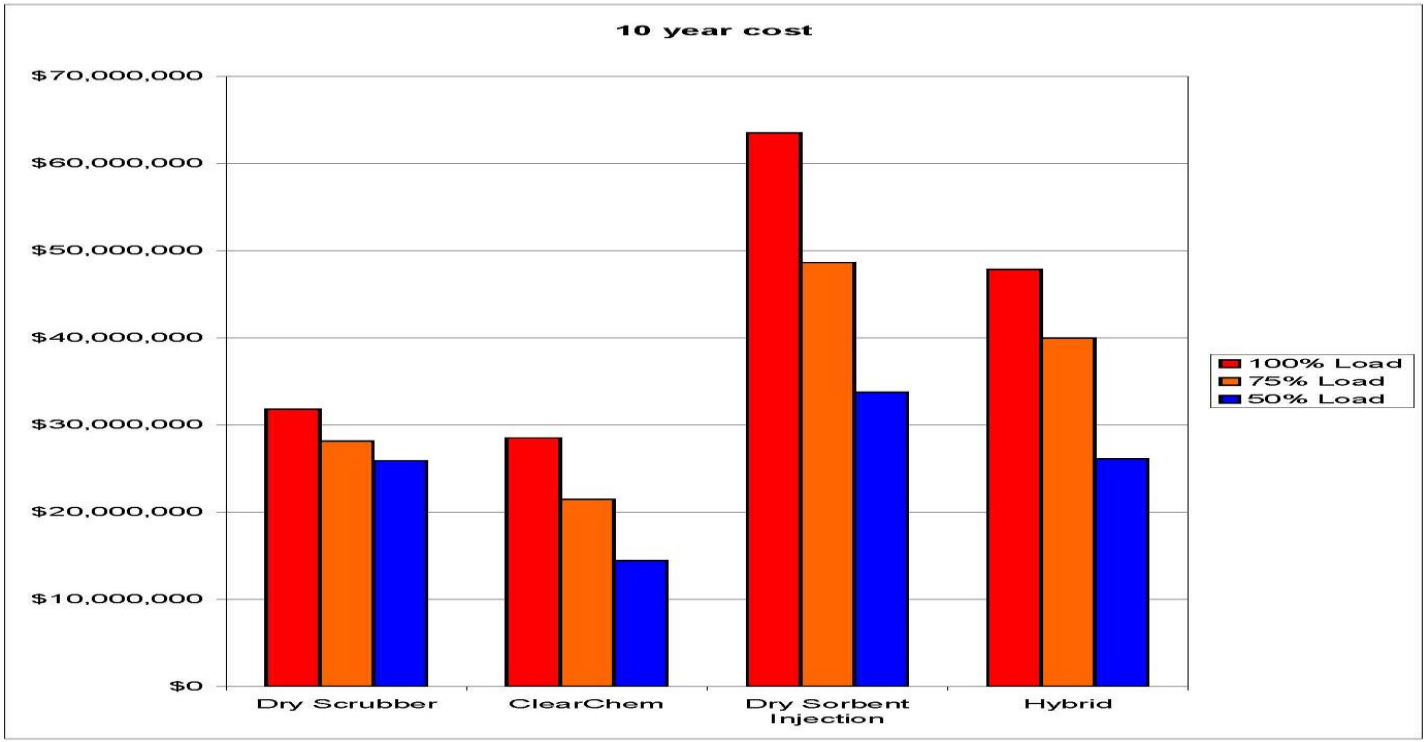
DOE Boiler Trials Using 325 Mesh Limestone Powder

EnerChem Incorporated

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 SO_3 & reap benefits
    - Reduce fuel consumption and CO_2 emissions
    - Recover H_2O from flue gas
    - Eliminate “blue plume”