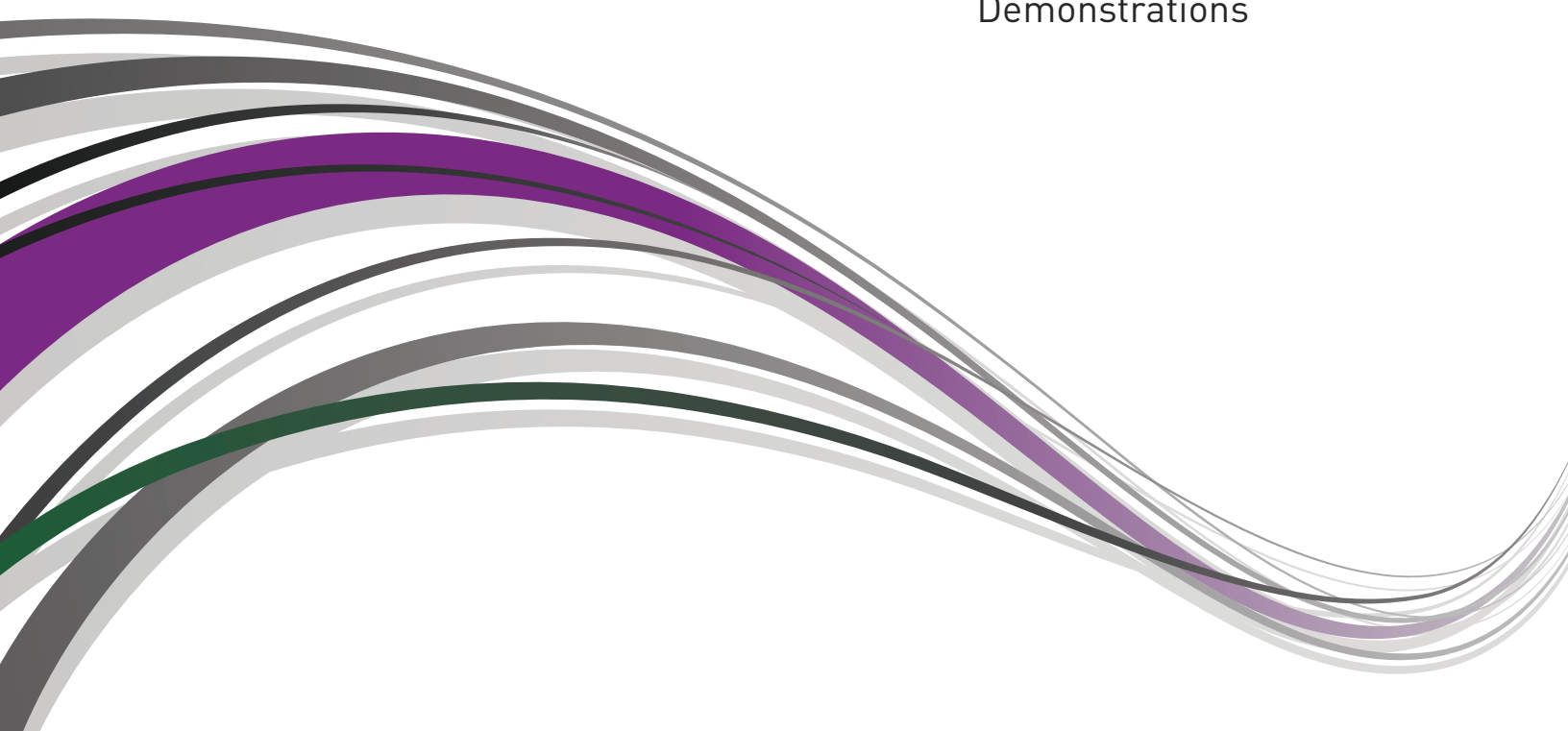




BREEN[®]

SMART SCIENCE • CLEANER ENERGY

Dry Sorbent Injection
Demonstrations



INTRODUCTION TO DSI

Breen Energy Solutions provides a broad range of technologies and services to the Fossil Fuel Power Generation Industry that help utilities manage their emissions, and the Balance- Of-Plant (BOP) impacts resulting from their emissions control systems.

Over the last six years, Breen has commercialized multiple technologies in the Acid Gas Management field based on deployment of the AbSensor - SO₃/ABS measurement system including Targeted Deposition Depth (TDD) for SCR/NH₃ control and Dynamic Speed Control (DySC) for enhanced air heater cleaning.

Now Breen has developed a suite of interlocking technologies to assist in plant Fuel Flexibility demonstrations. Baseline conditions for furnace/convective slagging, Air Heater differential pressure and post air heater sulfuric acid levels are characterized using specialized instrumentation. Then, based on consultation with plant staff, custom mitigation processes are mobilized. These include Dry Sorbent Injection (DSI) systems for SO₃ mitigation using Lime, Trona and other dry sorbents as well as a wet sorbent injection process employing injection of Magnesium Oxide for slag control and Calcium Hypochlorite for gas phase ammonia slip control.



BREEN HAS DEVELOPED A SUITE OF INTERLOCKING TECHNOLOGIES TO ASSIST IN PLANT FUEL FLEXIBILITY DEMONSTRATIONS.

As US Utilities enter the age of Utility MACT, CSAPR amid commercial viability concerns, a growing number of plants are exploring sorbent injection as an answer to compliance and efficiency requirements. Fortunately, or unfortunately, there are as many sorbents and injection locations as there are issues. In an effort to understand and quantify the performance of a selected sorbent process, individual plants often execute on-site demonstrations of the process. These demonstrations are expensive to mobilize and implement and an improperly designed or executed program can yield conflicting results.

Breen is uniquely positioned to provide sorbent and process independent guidance through this difficult process. Our experience with multiple coals, plant configurations,

sorbents and gas chemistries allows us to assist our customers in:

- Baseline/Characterization of existing plant SO₃ and HCl levels throughout the gas stream
- Assistance in proper Sorbent Selection based on plant specific process and performance drivers
- Injection Location and Bias determination to provide maximum condensable capture without negative impact on SCR, Air Heater and particulate control systems
- Process Optimization and Credible Evidence demonstration to provide hard evidence of both system operating costs and compliance assurance through normal plant operating variations



monitored to eight simultaneous injection locations. This allows determination of the proper amount of sorbent, as well as the proper distribution of that sorbent between functional injection locations for varying plant operating conditions (load, SCR performance, fuel sulfur, etc.).

Considering the potential for combined condensable/filterable particulate emissions limits, this approach allows the site to optimize the distribution of sorbent to match the distribution of acid vapors, minimizing both condensable and filterable emissions.

Process Optimization and Credible Evidence Development

Once the sorbent injection locations/splits have been determined, Breen program management works with plant engineering and environmental staff to develop an optimized injection process complete with predictive emissions feedback.

This last step is critical in that it provides the plant with continuous credible evidence that its sorbent injection process is in compliance with state and federal emissions requirements. Lack of this step often forces the plant to inject minimum fixed amounts of sorbent, regardless of changes in plant conditions. This forced minimum often causes both cost and balance of plant issues that can lead to landfill, water and process performance problems over time.

Baseline/Characterization

Each plant is unique in its ability to generate and dissipate SO₃ compounds. Breen's field engineering staff, using our patented condensable measurement technology, monitors the level of SO₃ based material at the Economizer Outlet, SCR Outlet, Air heater Outlet and ESP/FF Outlet during extended periods of normal plant operation. Comparing this information with plant historian data for such variables as boiler load, excess O₂, boiler cleanliness and SCR NO_x/NH₃ distribution provides a solid understanding of how and where sulfate compounds evolve in the plant gas stream.

Understanding the impact of normal plant operations on sulfate condensable is the first step toward designing a suitable sorbent injection process to control it.

Sorbent Selection

Based on the measure SO₃ compound life cycle, specific plant drivers are determined. These could include furnace/superheat fouling, SCR MOT issues, Air Heater fouling, ESP performance and corrosion issues and

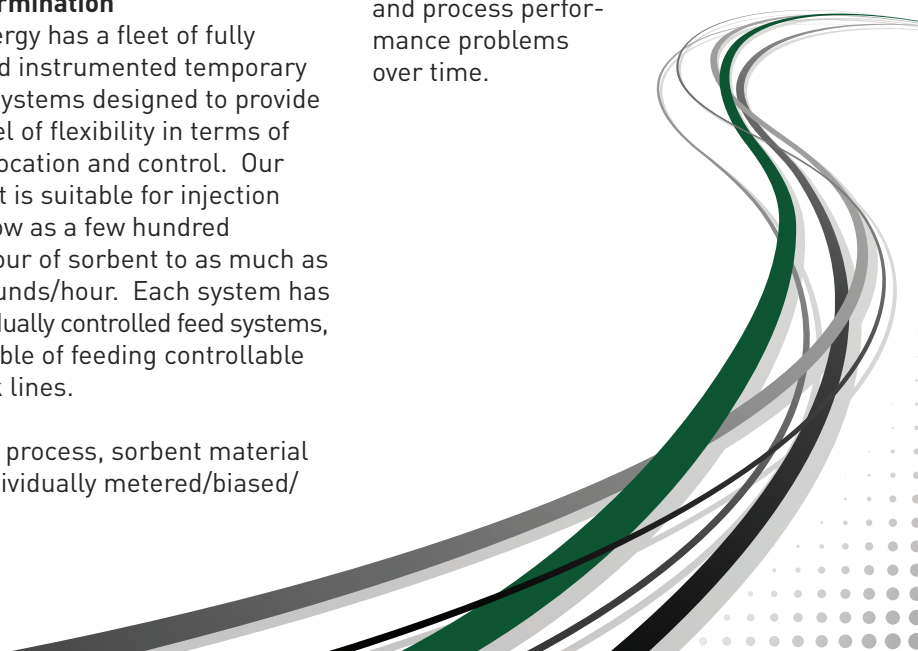
visible stack emissions (blue plume). Which sorbent (generally between magnesium, calcium and sodium based compounds) is best is a function of plant layout, operating issues and relevant air/water quality emissions requirements.

Breen has significant experience with all of these materials and works closely with the plant to select the sorbent most likely to provide controllable management of the plant's condensable related issues.

Injection Location and Bias Determination

Breen Energy has a fleet of fully staffed and instrumented temporary injection systems designed to provide a high level of flexibility in terms of injection location and control. Our equipment is suitable for injection rates as low as a few hundred pounds/hour of sorbent to as much as 20,000 pounds/hour. Each system has four individually controlled feed systems, each capable of feeding controllable split trunk lines.

Using this process, sorbent material can be individually metered/biased/





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THIRD PARTY, INDEPENDENT, SORBENT INJECTION DEMONSTRATION SERVICES:

Breen provides full, turn-key, demonstration services that allow the utility and the generating station to develop an understanding for the sorbent chemical and mechanical process, a commercial foundation for feasibility considerations and a working control/feedback process to assure compliance with both internal and external drivers.

Breen also provides a family of state-of-the-art measurement instruments for continuous monitoring of acid gas condensable compounds and gaseous HCl. These instruments all have significant track records in full scale, closed-loop control of acid gas mitigation systems.

Additionally, Breen provides a variety of specialty sorbents and processes to aid the electric generating industry in compliance with MACT and CSAPR requirements. These sorbents/processes include:

- Oil Based MgO dispersion for localized slag control
- Calcium Hypochlorite solution for Gas Phase Ammonia Slip Mitigation
- Fuel Lean Gas Reburn (FLGR) for simultaneous reduction in plant NO_x and SO₂ levels.