

# Flue Gas Conditioning (FGC) Systems

*Improve performance of electrostatic precipitators in the capture of fly ash and fine particulate emissions*

Most Electrostatic Precipitators (ESPs), designed to collect fly ash from coal-fired boilers do not operate effectively when there is an insufficient amount of sulfur trioxide ( $\text{SO}_3$ ) present in the flue gas. By injecting  $\text{SO}_3$  and, in some cases, ammonia into the flue gas the performance of ESPs is improved without increasing  $\text{SO}_3$  and/or  $\text{NH}_3$  emissions. The  $\text{SO}_3$  necessary for the FGC process is generated by the burning of elemental sulfur in order to produce  $\text{SO}_2$ , which passes through a vanadium pentoxide catalyst (exothermic reaction) and is converted to a mild  $\text{SO}_3$  gas/air mixture which is then injected into the flue gas at levels of 10-20ppm.

System installation costs can be greatly reduced by designing modular equipment. Whenever possible, our system design is "containerized" by factory-assembling the process equipment inside a permanent enclosure prior to shipment. This minimizes installation time and expenses, and negates the need for separate dedicated buildings.

Chemical feedstock costs and external energy input can be significant. As such, catalytic converters should be as efficient as possible to minimize the flow of molten sulfur feedstock to the system. For this reason, the standard catalytic converter is a two pass design, which produces an  $\text{SO}_2/\text{SO}_3$  conversion efficiency of 97%.



Our FGC systems are factory-assembled and arranged with maintenance and reliability in mind.

System maintenance hours can be lessened with the use of high-reliability components. Our standard diaphragm metering pump design is an improved design and safer than alternatives due to the incorporation of an internal pressure relief system. Controls for FGC systems conform to modern plant standards. Our systems are typically based on the Allen-Bradley PLC format, but DCS integration is also available.

Computational Fluid Dynamic (CFD) modeling is used to improve our injection probe designs. This allows us to bias the injection of  $\text{SO}_3$  which prevents any possibility for corrosion to develop in the cold side of the flue gas ducts.



Fuel Tech has over 50 FGC Systems installed worldwide

## Benefits

- Enhanced collection of fly ash when burning low quality coals
- Reduction in stack emissions and visible opacity
- Improve operation of Electrostatic Precipitators (ESPs)
- Reduction of precipitator sizing and capital requirements for new applications
- Continuous supply

# FGC Applications

*We design systems that are efficient, effective, and economical.*

## Molten Sulfur Systems

Molten sulfur is the most economical and common feedstock and is widely available in bulk shipments. Sulfur is non-hazardous and is reliably and accurately metered and transferred to the SO<sub>3</sub> production skid. The molten sulfur is heated to temperature with plant steam or via a small, electric steam boiler.

Equipment sequence:

- Molten Tank
- Metering Pumps
- Injection Probes
- SO<sub>3</sub> Production Skid
  - Air Blower
  - Air Heater
  - Sulfur Burner
  - SO<sub>2</sub>/SO<sub>3</sub> Converter

## Pelletized Sulfur Systems

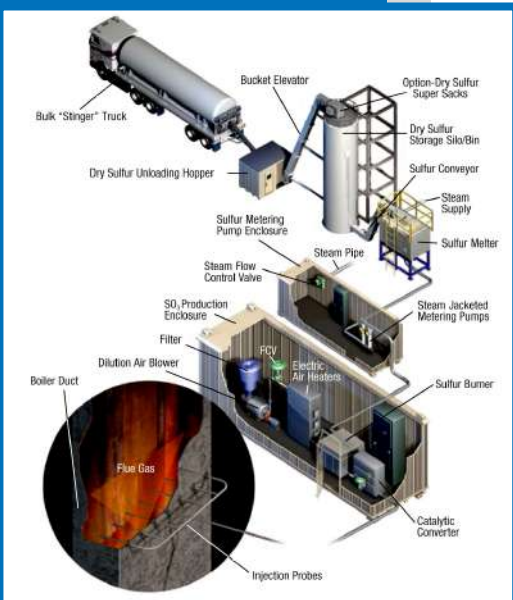
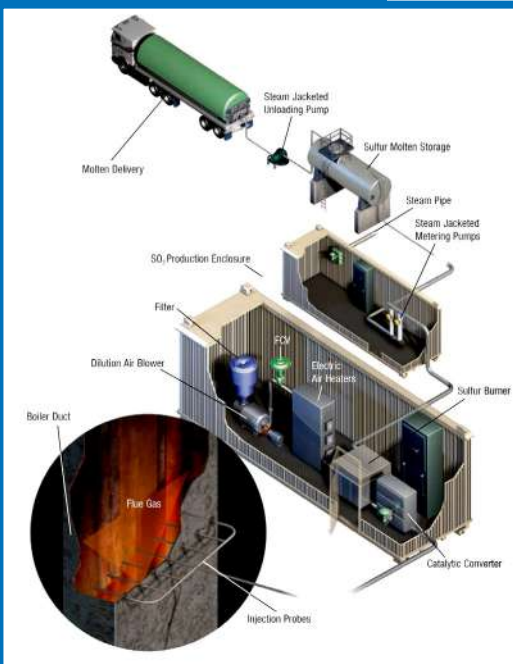
Pelletized Sulfur systems provide substantial benefits, especially for smaller capacity units. They eliminate the unloading of hot molten sulfur, reduce steam usage and the amount of steam jacketed interconnecting process piping. Pelletized sulfur is non-hazardous, shipped in one ton super sacks or in bulk transfer trucks and can be stored indefinitely without need for steam heating. Systems have much more flexibility in sulfur storage location and equipment layout.

Equipment sequence:

- Dry Unloading
- Dry Silo with Conveyor
- Sulfur Melter
- Metering Pumps
- Injection Probes
- SO<sub>3</sub> Production Skid
  - Air Blower
  - Air Heater
  - Sulfur Burner
  - SO<sub>2</sub>/SO<sub>3</sub> Converter

## Ammonia Systems

Ammonia (NH<sub>3</sub>) systems are available using anhydrous or aqueous ammonia, and also urea solution. The use of NH<sub>3</sub> is effective alone in certain precipitator enhancement applications, or also in conjunction with SO<sub>3</sub> injection creating a “dual” conditioning process. These systems provide a wide range of size availability while using urea, a safer reagent. Dual FGC systems are often required for acidic fly ash applications where the use of SO<sub>3</sub> FGC by itself is insufficient in reducing fly ash resistivity.



System Configurations for Molten Sulfur and Pelletized Sulfur FGC applications