45% NOx Reduction Goal Met by Use of Spray Injectors

Problem:

Faced with a compliance deadline established by the Environmental Protection Agency's Clean Air Interstate Rule (CAIR), a power plant in the midwestern US needed to find a NOx control system that would reduce emissions by 30 to 50%. Plant personnel requested a proposal from a leading air pollution control equipment company. The recommended solution was a custom system with a US$1,000,000 price tag. Plant personnel decided to explore more options.

Acting on a referral from another power plant in the region, plant personnel contacted Spraying Systems Co. and requested a proposal. The utility provided furnace parameters and geometries and Spraying Systems Co. collected sample temperature readings.

Solution:

Using proprietary gas cooling calculations, drop size data collected in its test labs and decades of experience, Spraying Systems Co. designed a solution:

- Eight air purge injectors installed on three levels
- Each injector equipped with a hydraulic hollow cone nozzle spraying a water/urea mixture perpendicular to the furnace wall
- Injectors to withstand temperatures up to 1750°F (954°C)
- Air purge to keep urea cool enough to prevent vaporization and nozzle clogging

The inner pipe and inlets are constructed of 316 stainless steel; the flange, outer pipe and nozzle are 310 stainless steel.

WhirlJet® Hollow Cone Spray Nozzle: 310 stainless steel

Gas Outlet

Heat Exchangers

Spray Injectors

Coal Combustion

2 burners on each of 3 levels
Design Validation:

CFD (Computational Fluid Dynamics) modeling was recommended by Spraying Systems Co. to validate the design and uncover any unforeseen problems caused by the operating conditions in the furnace.

Results:

The CFD study validated the design and no modifications were required. The injectors were constructed and installed in 12 weeks.

- NOx emissions have been reduced by 45%
- Urea carryover is negligible and within acceptable limits
- Nozzles are clog-free and injectors are performing to specification
  - The mixing of the urea in the gas stream is adequate and the desired reaction occurs
  - The droplets produced by the hollow cone nozzles are evaporating prior to contact with furnace walls, eliminating damage and excess maintenance caused by wetting
  - The use of hydraulic nozzles eliminates the need for costly compressed air and helps keep operating costs low
- The Spraying Systems Co. solution was just 1/3 of the cost of another supplier’s, saving the power plant several hundred thousand dollars (US)
- The project was completed several months before the compliance deadline. The power plant earned emission credits that can be sold in the future