

# TODAYS BOILER

TRENDS, TECHNOLOGIES & INNOVATIONS

## *boiling* points

Selection and technology tips  
from the experts

The Official Magazine of



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**TOTAL PLANT SOLUTIONS:**

BY LARRY K. DAY



**A PRIMER ON SELECTIVE CATALYTIC REDUCTION (SCR) DISPLAYS ITS CASE AS AN ALTERNATIVE TO BURNER TECHNOLOGIES.**

Companies today face many operating challenges, including meeting current and future air emission requirements, energy efficiency demands, safety requirements, and tough economic conditions. Equipment providers must offer technology solutions that not only provide a favorable return on investment and profitability, but which also consider the technology's total cost of ownership and future compliance readiness.

During the 1990s, advancements in front-end combustion technology resulted in the development of low NOx burners

which could achieve NOx emissions in the range of 30 parts-per-million (ppm) for gas-fired applications. This technology was based on controlling the formation of thermal NOx and involved staged combustion and flue gas recirculation (FGR) to reduce peak flame temperature during the combustion process. Drawbacks of these methods in some applications could include high operating costs and boiler efficiency losses due to increases in fan horsepower requirements and excess air requirements.

Further burner advancements have been developed over the last several years to meet demands of sub-10 ppm appli-

cations. However, these ultra-low NOx burner (ULNB) technologies, with their high FGR or excess air rates, compromise even further the operational limits of boiler equipment, resulting in limited turndown capabilities, flame pulsations, and unstable operation. Burner research and technology is currently underway to meet the challenges of providing reliable and predictable operational results, while meeting ever-changing emission requirements.

## SCR ON THE SCENE

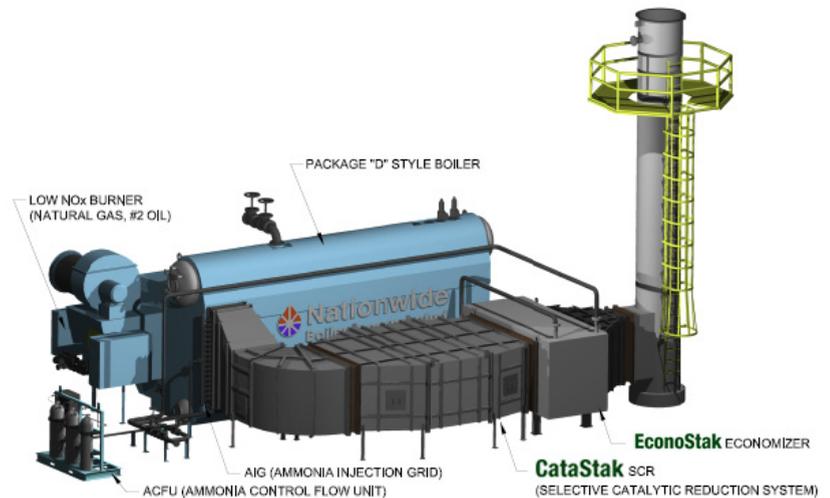
A readily available alternative to burner technology is the use of selective catalytic reduction (SCR) technology. SCR systems are a back-end technology solution that does not affect flame stability and burner performance, while achieving NOx emission levels of less than 5 ppm. Since its development in the early 1960s, SCR systems have successfully been used as a pollution control technology method capable of removing 90% or more of NOx emissions in the flue gas of boilers, turbines, heaters, and furnaces.

SCR technology uses catalyst and ammonia as a reducing agent to convert NOx to nitrogen and water. The catalyst material is usually either in a pelletized or honeycomb form, consisting of titanium dioxide mixed with oxides of vanadium pentoxide. Ammonia can be supplied in either anhydrous, aqueous, or urea form. SCR systems can be configured either vertically or horizontally and are composed of an ammonia control flow unit, ammonia injection grid, and a modular reactor house for the catalyst bed.

Today's SCR systems can perform efficiently across a flue gas temperature range of 325° to 850°F, and in some instances, can safely operate without the need of a HAZMAT/risk management program. A SCR system can also provide a total emissions/efficiency solution when used with extended surface finned tube economizers to capture valuable waste heat and sending it back into the boiler feedwater or makeup water, thus decreasing operating costs.

Moreover, in some cases SCRs have also benefited systems which have had capacity decreases due to the use of flue gas recirculation. However, similar to burners, SCR technology also has several drawbacks, including ammonia handling concerns, space limitations, and high installation costs in certain cases.

When evaluating the best solution for any application, several factors must be taken into consideration. Based on today's trend



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to lower emissions and increase energy efficiency, the best solution includes the following: an adequate payback, decreased operating costs, the lowest possible NOx levels in order to meet future compliance requirements, and energy efficiency.

## CASE STUDIES

The following are examples of how differing industries have benefitted from a SCR solution and are reaping the benefits of both huge emission reductions and energy efficiency savings.

Del Monte Foods Company installed a new high-efficiency, ultra-low NOx package boiler at the company's fruit processing and packaging plant in Modesto, CA. The unit, used for process steam, was certified to operate at better than 95% fuel-to-steam efficiency with less than 2.5 ppm NOx emissions. The efficiency and clean operation of the boiler earned Del Monte Foods an energy efficiency rebate from the local utility, Pacific Gas & Electric (PG&E). The low NOx emission level of 2.47 ppm fell well below the currently allowable limit of 9 ppm estab-

**"Based on today's trend to lower emissions and increase energy efficiency, the best solution includes the following: an adequate payback, decreased operating costs, the lowest possible NOx levels in order to meet future compliance requirements, and energy efficiency."**

lished by the San Joaquin Valley Air Pollution Control District (SJVAPCD), one of the most demanding air quality districts in the country.

The resulting low 2.47 ppm NOx emission level was accomplished using one of Nationwide Boiler's SCR systems coupled with a standard 30 ppm burner. The system's CO emissions of 7.3 ppm are significantly below the allowable 50 ppm level.

Current boiler operations include use of up to 20% flue gas recirculation (depending on the boiler load) and feedwater heating that is accomplished using a Kentube exhaust-stack economizer and a Benz Air condensing heat exchanger which lowers the stack temperature to 93°F. Overall, operating efficiency and emission levels are essentially constant across the entire boiler turndown range.

Elsewhere, a major California food processor based in the Central Valley retrofitted a SCR system on a 700 hp (29.3 MMBtuh) natural-gas fired Cleaver-Brooks firetube boiler, equipped with a low NOx burner. Nationwide Boiler guaranteed operations at less than 5 ppm, and third-party vendor testing indicated that the unit exceeded initial guarantees. Overall, it was certified to operate with less than 0.5 ppm NOx emissions (reported as less than the minimum detection limit of the testing method used), and average ammonia slip was reported at only 0.3 ppm. Also, the unit operated successfully between a stack temperature range of 330° to 366° F (low to high fire), which proved that today's SCR catalyst can operate at much lower temperatures than previously thought possible.

Nationwide Boiler retrofitted a 40,000 lb/hr Babcock & Wilcox boiler with a different solution, comprising an SCR system and an economizer located in the heart of the University of California campus in Riverside, CA. An ammonia safety system was designed for the ammonia delivery system that included ventilating fans and ammonia detection devices to increase the safe handling of ammonia.

The equipment supplied easily met the 5 ppm ultra low NOx emission requirements, which ensures that the equipment will meet future NOx emission limits required by the local air quality management district. The economizer reduced stack temperature from 450°F to 300°F, resulting in a nearly 4% increase to the current boiler's overall efficiency and providing an immediate energy cost savings. **TB**



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