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 **ESC**
Energy Solutions Center

GAS Technology

 **Design Innovations
Improve Plant Boilers**





Boiler Designs Being Transformed

Major Efficiency and Emission Improvements

In a situation that is frequently repeated in the industrial world, an American Insulated Wire (AIW) plant in Coffeyville, Kansas recently re-evaluated its plant process steam system. The plant uses steam at 250 psi to cure rubber insulation on copper building wire. AIW concluded that two existing 350 bhp boilers were oversized, inefficient, and expensive to operate.

AIW chose to replace them with two modern, automated boilers by Clayton industries.

BIG SAVINGS EVERY MONTH

According to AIW facilities engineering manager Joe Wilkinson, the fuel savings with the new boilers range from \$8,000 to \$14,000 per month. What's more, the more compact boiler design conserves plant floor space for fork-lifts and other equipment.

One would think the technology of the modern steam boiler is mature. Yet important improvements continue to be made every year to boiler designs. This is especially true for packaged steam boilers for large commercial and industrial applications.

COMPUTER MODELING ACCELERATES IMPROVEMENT

Today, boiler designers can evaluate hundreds of design innovations using advanced computer-based thermodynamic modeling, making possible the aggregation of dozens of small but mean-

ingful efficiency improvements and emission reductions, particularly at part load conditions.

Digital combustion controls and diagnostics have made possible improvements in unit efficiency and emissions control and better predictive maintenance programs for boilers. Further, the steady improvement in high-temperature metallurgy has allowed boilers to stretch the limits of operating pressures and temperatures.

MANUFACTURERS STEP UP TO NEW CHALLENGES

Steve Connor from Cleaver-Brooks is proud of the way his company has solved design challenges facing today's boiler manufacturers. Stressing the importance of the boiler burner, he says that "facing the challenge of the 21st century to generate steam or hot water with high fuel efficiency, and low or ultra-low NO_x emissions to reduce smog in the air requires advanced engineering practices using sophisticated technical and modeling tools."

As an example of the results achievable with computer-assisted design tools, he cites Cleaver-Brooks' most recent boiler designs, the Promethean™ Model 4WI and Criterion™ Model ICB. He indicates that with these boiler designs, optimum combustion and heat transfer begin with the fuel and air delivery system and progress to the firing head where the proper amounts of fuel and air are united to form a highly combustible mix.

AT A GLANCE

- Boiler innovation still happening
- Computer design tools important
- Combustion optimization improves
- Burner designs for NO_x reduction



A cutaway view of the combustion mixing in the recent Cleaver-Brook ICB boiler design

MEETING TIGHTENING NO_x STANDARDS

Industry specialists feel that a good part of the innovation in the gas-fired boiler industry is directed at reducing NO_x emissions. According to Lee Kosla, senior vice-president of sales and marketing for Alzeta Corporation, a high priority is achieving the single-digit ppm NO_x standards in large non-attainment areas such as in California and Texas. "We are in a three-year phase-in of the standard in these industrialized areas, and we're seeing growing demand for ultra-low NO_x compliant burners."

Alzeta provides burners and combustion technology for both firetube and watertube boilers with its CSB™ product for hot water and steam applications up to 130 MMBtu/hr. For smaller units, ALZETA has teamed with Power Flame Inc. with the introduction of the Nova Plus™ burner for commercial and light

For More Information

Alzeta Corporation
www.alzeta.com/

Clayton Industries
www.claytonindustries.com/

Cleaver-Brooks
www.cleaver-brooks.com/

Fulton Boiler
www.fulton.com/

Lochinvar Corporation
www.lochinvar.com/

Miura Boiler
www.miuraboiler.com/

Parker Boiler
www.parkerboiler.com/

Power Flame, Inc
www.powerflame.com/

industrial boilers between 2 MMBtu/hr and 25 MMBtu/hr.

The CSB technology uses a porous-walled, hollow cylindrical burner head installed within the combustion chamber to dramatically reduce NO_x emissions without requiring the use of fuel or air staging, flue gas recirculation, or other approaches requiring complex controls.

PULSE COMBUSTION FROM FULTON

Fulton Boiler manufactures a wide range of vertical and horizontal packaged boilers which are widely used in commercial and industrial applications, including garment manufacturing, dry cleaning and food processing. One innovative

product offered exclusively by Fulton is a pulse combustion boiler. Pulse combustion is a method used to create a turbulent flow, thus maximizing the complete combustion of all fuel and providing a very efficient boiler operation.

Fulton today also specializes in the fabrication of skid-mounted modular boiler systems. These are especially valuable for boiler retrofits, where access to the boiler room is limited. In one recent installation at a research laboratory on Long Island, the company provided eight 9.5 hp boilers. Each boiler had its own feedwater and blowdown systems to facilitate maintenance of units individually. The entire system was designed to fit through a 36" doorway.

Clayton Industries is another boiler manufacturer taking advantage of advanced research and design tools. The company manufactures a wide range of boilers and heat recovery equipment ranging in size from 20 to 700 bhp, and they serve a wide range of industries, including chemical processing, petroleum, food processing, paper, and hotels and resorts.

NEW CLAYTON HEAT EXCHANGER REDUCES BOILER SIZE

Recent developments by Clayton include a new boiler model called SigmaFire™. This unit was designed to reduce the overall footprint and to include all of the feedwater equipment as modular components. According to Clayton's Eric Kessler, "This new modular product will greatly reduce the cost to the owner for a new or replacement boiler system."

Clayton has also developed the Compusteam PLC™ controller for its larger units. This controller provides instant, accurate control of feedwater and steam conditions, and allows data acquisition of a wide range of information including feedwater conditions, pH, oxygen content, and firing rate.

As a general trend in smaller boilers, field-erected units are being replaced by more compact boilers.



Zero sidewall clearance design of the Lochinvar boiler allows multiple units to be installed in a very small space.

DESIGNS FOR UNATTENDED OPERATION

Newer boilers are designed to function more automatically, including models for complete unattended operation in sizes below 100 bhp.

Because of the improving efficiency and costs of smaller boilers, it is becoming increasingly popular to install these in combinations of multiple units for both commercial and industrial installation.

Smaller units such as the Lochinvar Intelli-Fin® boiler rated at 2 million Btu/hr have advanced digital control capabilities suitable for industrial installation. The Intelli-Fin has a zero clearance requirement between units, so multiple boilers can be installed in a relatively small space.

Miura Boiler is another major manufacturer of packaged steam and hot water boilers in sizes up to 300 horsepower, and specializes in boilers designed and factory fitted for multiple boiler installations. The Miura boiler is designed for very fast startup — steam within five minutes — and is especially attractive for retrofit installations because of their small footprint.

The supposedly "mature" technology of gas-fired boilers is showing a remarkable amount of innovation and improvement. Efficiency improvements allow owners to keep operating costs under control, and emission reduction strategies play a key role in air quality improvement. For many owners, it's a new "Age of Steam."

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A skid-mounted Fulton horizontal boiler