Old Dog, New Tricks

Welch Goggins, President and Chief Executive Officer of Cleaver-Brooks Inc.; Chairman of the ABMA

About 80,000 boilers aged 30 years or older operate in U.S. facilities today. The older the boiler, the less efficiently it runs, and the more unsafe and unreliable it may be.

But don’t just accept these drawbacks as inevitable. With the technological advances we’ve seen in the past few years, companies can achieve energy savings of 10 to 20 percent— without purchasing a new system. New, more efficient equipment that helps reduce greenhouse-gas emissions, fuel consumption, and water consumption— coupled with conservation measures and a general tightening of distribution systems—can provide a much “greener” boiler fleet.

A high-efficiency boiler is one way to reduce fuel costs, but lower-cost retrofit options, such as new burners, controls, and waste-heat-capturing ancillary equipment, are also available and nearly as effective.

Condensing Boilers

Rather than conventional steam boiler systems, condensing boilers offer one alternative for applications such as heating, wash-down and food service. Condensing boilers serve the hot water needs of a facility at the highest efficiency available.

For smaller facilities that maintain steam applications without using instantaneous steam heaters, installing a smaller steam boiler for process work and a condensing boiler for building heat can be a good way to maximize the use of boiler capacity and save energy.

Emissions & Energy Savings

There are several options to reduce emissions, including upgrading or adding retrofits to your burners. Properly designed burners will produce low levels of nitrogen oxide (NOx) and carbon monoxide (CO), the two most heavily regulated emissions. However, flue gas recirculation (FGR) offers the largest emissions improvements. FGR reduces peak flame temperatures, thereby reducing NOx generation. It’s available as a retrofit option or as part of a new burner.

When it comes to energy savings, a high-turndown burner can help. Most small burners turn off when the boiler water reaches the desired set point and back on when the water or steam drops below the set point. For each of these cycles, large volumes of air pass through the boiler, resulting in heat simply blown out the stack. A high-turndown burner minimizes the number of cycles.

Finally, an economizer can increase boiler efficiency up to four percent by transferring heat energy from the boiler exhaust gas to the boiler feed water in the form of “sensible heat.” This reduces the boiler exhaust temperature, while preheating the boiler feed water.

Other energy-efficiency retrofit control options to improve system performance:

- **Parallel positioning** helps maintain air-to-fuel ratios. It generates less excess oxygen in the stack and optimizes combustion, thus increasing efficiency.
- **O2 trim systems** increase efficiency up to two percent. They use an oxygen sensor/transmitter in the exhaust gas. The controller then “trims” the air damper and/or gas valve, maintaining a consistent oxygen concentration and optimal performance.
- **Variable speed drive (VSD) control options** allow a motor to operate at only its required speed, rather than a constant 3,600 RPM. That means the motor burns less fuel and requires less maintenance for motors and fans.

Technology To The Test

Many of these technological changes were incorporated into the Super Boiler, the result of collaboration among several energy industry partners including Cleaver-Brooks, the U.S. Department of Energy and the Gas Technology Institute. The goal was to create a boiler that would achieve high efficiency rates, produce fewer emissions and help reduce U.S. industrial steam system operating costs by more than $10 billion a year and save 185 trillion BTUs by 2020.

The test model operating at Specification Rubber Products Inc., Alabaster, AL, so far has delivered astounding results: Fuel-to-steam efficiency has been consistently 93 to 94 percent—versus traditional boilers with less than 80 percent efficiency. In addition, fuel savings have averaged around 13 percent, and NOx production has been less than 9 parts per million by volume.

Decreasing Water Usage

These results were achieved by looking at the same components outlined above. The Super Boiler’s controller is Cleaver-Brooks’ CB Hawk ICS, which actively monitors efficiency trends and helps systems operators recognize when performance problems occur. This gives time to correct problems before heat and energy losses become an issue and increased fuel costs are incurred.

The heat transfer service uses Alufer® tubes, providing five times the heat transfer rate of bare tubes. This allows the boiler to be much smaller than traditional boilers.

For optimal heat recovery, the Super Boiler uses dual economizers as well as a transport membrane condenser (TMC) and a compact humidifying air heater (HAH). The TMC extracts sensible and latent heat from the flue gas, while dehumidifying exhaust gases. The HAH preheats and humidifies the combustion air to increase efficiency.

While the Super Boiler won’t be available commercially until at least mid-2009, that doesn’t mean companies should wait: technology has expanded the number of retrofit options to reduce fuel costs.