



# SHOP TALK

VOLUME 13, ISSUE 3

JULY 2011

## Realize the Benefits of Retrofits

As a contractor, you know how critical steam can be to a building's power, process heat and indoor climate control needs. Additionally, one-third of a facility's energy bill stems from the boiler room and system inefficiency leads to higher energy costs. Replacing an older boiler is one way to achieve significant energy savings, but it is not the only option. There are other ways to improve efficiency. Retrofitting an old boiler is one way to bring it nearly up to par with today's new systems.

The main cause of energy inefficiency is system heat loss. The average level of efficiency for industrial boilers is only 75 percent.

### TAKE CONTROL OF YOUR SAVINGS

The first place to look for improvements is in the control system. The following new control developments produce measurable efficiency increases and fuel-cost reductions and they can be retrofitted into an existing system.

1. **Parallel Positioning** — Many boiler burners are controlled by a single modulating motor with jackshafts to the fuel valve and air damper. This arrangement, set during startup, fixes the air-to-fuel ratio over the firing range. Unfortunately, environmental changes such as temperature, pressure and relative humidity alter the fixed air-to-fuel ratio, making combustion inefficient. To account for these conditions, boilers with jackshaft systems are typically set up with a high amount of excess air. This higher excess air level reduces boiler efficiency and, over time, linkages wear—making repeatability impossible.

To solve this problem, consider incorporating parallel positioning into the control system. It is a process using dedicated actuators for the fuel and air valves. Burners that incorporate parallel positioning can be set with lower excess air levels. Energy savings of up to five percent can be realized by introducing a parallel positioning system.

2. **O<sub>2</sub> Trim** — Another way to ensure peak efficiency is to use an oxygen sensor/transmitter in the exhaust gas. The sensor/transmitter continuously senses

oxygen content and provides a signal to the controller that “trims” the air damper and/or fuel valve, maintaining a consistent oxygen concentration. This minimizes excess air while optimizing the air-to-fuel ratio.

3. **Variable Speed Drive** — Variable speed drives enable a motor to operate only at the speed needed at a given moment, rather than a constant 3600 RPM for example. This speed variance results in the elimination of unnecessary electrical energy consumption. A variable speed drive can be used on any motor but is most common on pumps and combustion air motors of greater than five HP. These drives also produce quieter operation compared to a standard motor and they reduce maintenance costs by decreasing stress on the impeller and bearings.

4. **Lead Lag** — Lead lag sequences the operation of multiple boilers, matching system load. Lead lag enables the boilers to operate at peak efficiency, reduces cycling and decreases maintenance and downtime.

### TAKE BACK THE HEAT

Another way to please budget scrutinizers, while improving energy efficiency, is to incorporate heat recovery retrofits into the boiler system.

1. **Economizers** — Economizers transfer energy from the boiler exhaust gas to the boiler feed water in the form of “sensible heat”. Sensible heat is created by the transfer of the heat energy of one body, in this case exhaust gas, to another, cooler body — the boiler feed water. This reduces the boiler exhaust temperature while preheating the boiler feed water increasing overall efficiency. Economizers typically increase energy savings by 2.5 percent to 4 percent.



Adding a standard economizer to a boiler can increase energy savings by 2.5 to 4 percent on average.

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2. Two-stage Condensing Economizers — This type of economizer combines the functions of both a standard non-condensing economizer and a condensing economizer. The first section of the economizer recovers energy by preheating boiler feed water. The second section recovers energy by preheating a cool liquid stream such as make-up water. Sensible and latent energy is captured from the flue gases that leave the boiler. Condensing economizers can increase energy savings by up to 10 percent, depending on design and operating conditions.

3. High Turndown Burner — Increasing burner turndown rate will create energy savings and reduce maintenance. Energy savings are realized due to a reduction of on-off cycles. Each on-off cycle is followed by purge cycles. During a purge cycle, large volumes of room air pass through the boiler, resulting in heat being blown out of the stack.

4. Blowdown Heat Recovery — All boilers must remove dissolved solids from the boiler to maintain water purity and ensure a long boiler life. Many boiler rooms route blowdown to a flash tank that allows safe discharge of the steam by reducing (flashing) the steam pressure in an enclosed tank. Low-pressure steam is vented from the tank and condensate is discharged to the drain. In many cases, these tanks are not insulated nor do they allow recovery of the lost heat. A blowdown heat recovery system transfers the blowdown steam energy to the boiler feed water, recuperating about 90 percent of this energy.

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## Pump Life Into That Old Steam Boiler

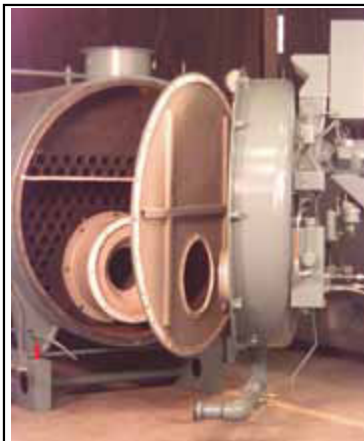
It is often said that once a steam boiler reaches 20 to 25 years of service, it's worn out, outdated and ready to be replaced. In reality, this could be a very costly mistake.

Boilers are long-term assets, and if operated and maintained according to the manufacturer's recommendations, they can last 40-50 years. The key is how the equipment is managed and (chemically) treated.

High pressure steam boilers are routinely shut down annually for cleaning and inspection. If you have an older boiler, inspection is the perfect time to evaluate its condition and determine if replacement is right. Once the boiler is off-line and drained, check the condition of the pressure vessel on both the fireside and waterside. If there is no evidence of heavy scale, overheating or corrosive attack, this boiler has many more good years in it, and may only need to be tuned and/or retrofitted to bring its performance to a higher efficiency and present day standards.

### Start with a tune-up and load check

After the boiler is cleaned, closed, and the pressure



If a boiler pressure vessel is in good shape, a tune-up and/or upgrades will increase its energy efficiency.

vessel is determined to be sound, use the services of a qualified technician to run the boiler through its paces. This should include checking the efficiency under normal operating conditions, modulating the burner throughout the complete firing range, while monitoring boiler efficiency along the way. If the overall efficiency is less than 80%, pay to have the boiler tuned to see if the efficiency can be increased to at least 80% when operating between 85-100% of its rated input. Next, determine if the load is properly matched to the boiler by noting its operation, ensuring that it fires over 50% of its capacity most of the time,

without cycling more than six (6) times an hour. If it does cycle excessively, the boiler is probably oversized for the load and operating very inefficiently because of the repeated cycling and resultant pre- and post-purge losses. In this case, a smaller (capacity) boiler (new or used) might be a good option during those lower load periods, keeping the larger boiler for standby or use during the high-load conditions. Or, if the load is not too reduced, consider a higher turndown burner retrofit on the old boiler, keeping it on line during periods of lower loads, mitigating the expensive cycling losses.

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## *Cleaver Brooks Clear-Fire* Compact Gas-Fired Boilers

### Clear-Fire V

- Vertical Steam Boiler
- 10-60 HP
- Natural gas and propane
- 150 psig
- Standard at <20 ppm NO<sub>x</sub>, <10 ppm CO

The Clear-Fire V is a carbon steel, vertical, gas-fired, steam boiler available in eight sizes. The linkage-less burner provides up to 5:1 turndown. 83% efficiency is achievable for low pressure and 85% high-pressure steam with an optional flue gas economizer package. Skid packages, including steam boiler, feed system, and blow down separator, are available for turnkey steam solutions.



### Clear-Fire H



- Horizontal Steam Boiler
- Steam Boiler
- 10 to 60 HP
- Natural gas and propane
- 15 or 150 psig
- Standard at <20 ppm NO<sub>x</sub>, <10 ppm CO

The Clear-Fire-H is a horizontal, gas-fired, steam boiler available in eight sizes. The linkage-less burner provides up to 5:1 turndown. 83% efficiency is achievable for low pressure and 85% high-pressure steam with an optional flue gas economizer package. Skid packages, including steam boiler, feed system, and blow down separator, are available for turnkey steam solutions.

### Clear-Fire C

- Fully condensing hot water boiler
- 500 to 2,500 MBTU
- Natural gas and propane
- 125 psi
- Standard at <20 ppm NO<sub>x</sub>, <10 ppm CO

The Clear-Fire-C is a vertical down-fired, stainless steel, full condensing boiler, available in six sizes. This unit will offer up to 99% efficiency. The linkage-less burner provides up to 5:1 turndown.



### Clear-Fire W



- Near condensing hot water boiler
- 400 to 2,400 MBTU
- Natural gas and propane
- 125 psi
- Standard < 20 ppm NO<sub>x</sub>

The Clear-Fire W is a compact, carbon steel, near-condensing boiler available in seven sizes. The combustion system with premix down-firing burner control automatically adjusts the air/gas mixture for efficiencies up to 88%. The linkage-less burner provides up to 5:1 turndown.



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### **New burner and controls**

If the boiler is properly sized to load, and the efficiency after tune-up is still below 80%, it is most likely time for a new burner or upgrade. If the burner's major parts (motor, damper blade(s), blast tube, burner baffle and diffuser) are in good condition, an upgrade should be considered. This may include replacing the single-point positioning linkage system with independent servo drives for fuel and air metering. You may also consider O2 trim and VFD, if the conditions are right and payback can be realized.

Lastly, look at the burner management system, also known as the flame safeguard or programmer. This is the control that automatically sequences the burner, supervising boiler/burner start, modulation and shutdown. It has evolved over the years to give you better operating information and fault indicators to enhance diagnostics and

troubleshooting. The control can also be incorporated within a PLC platform to include other combustion control devices such as parallel positioning, O2 Trim, VFD, etc., thereby, having one integrated system for the operator. This will enhance real-time, operational knowledge while providing instant communication to various parts of the facility, and/or offices across the country.

Boilers are key assets within a production facility that deserve close attention not only from the utilitarian and process control perspectives, but also from a cost perspective as well. On average, a boiler consumes four times its original cost in fuel expenditure annually, and if properly evaluated, maintained and operated, it can return wealth to the business that otherwise would have been squandered in needless capital expenditures and operating dollars.

## **I Hate Moving**

Due to a series of circumstances I have moved three times in the last three years. It was only supposed to be twice, but because our and the vendors real estate agents didn't do their due diligence we were forced to move into a rental house for the past 9 months. The house we recently purchased had renters and when we made our offer to purchase, we requested vacant position as of a specific date. The offer was excepted and we proceeded to sell our home. Three weeks prior to moving we got a call from our agent informing us the renters were not going to be moving out as their condo was not ready for them and since they had a lease for another year, they would be staying until the condo was indeed ready for them. This turn of events caused quite a bit of consternation with my wife, as you could imagine. Here we are packed and ready with nowhere to go. As it turned our neither real estate agent had checked to see when the tenants lease expired and they were perfectly within their rights to stay until the end of it. After many phone and e-mail conversations, we ended up having to get our lawyer involved and an arbitration meeting was set up. Meanwhile the clock is ticking and we are getting closer and closer to being homeless. We ended up coming to terms with the vendor and his agent and the vendor had to pay our living expenses until we could take vacant position of the house plus our moving expenses and lawyer fees and some incidentals. We found a house to rent with only two weeks to go before we had to vacate our home and for the last 9 months we have been living out of boxes until we could get into the new house. This whole ordeal could have been avoided if only one of the agents had asked to see the lease and what the term of same were. So my advice is if you're buying a house and there happen to be renters in it, get a copy of the lease and have the tenants sign a contract saying they will vacate the property on a specific dates prior to the closing.

Kerry Johnson