PIPE LINE
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COMMERCIAL/INDUSTRIAL/INSTITUTIONAL MECHANICAL CONTRACTORS SPRING 2009

# Does Your Boiler Need A Retrofit?

As a facility engineer or property manager, you know how critical steam is to a building's power, process heat and indoor climate control needs. With one-third of a facility's energy bill coming from the boiler room, system inefficiency is the main contributor to unnecessary energy cost. But purchasing a new high-efficiency boiler, or replacing an older boiler, can be a huge expense for a building owner.

Today, almost 80% of boilers in the United States are nearly 30 years old or older, according to the Department of Energy. Chances are pretty good that you're working with one that isn't operating at optimal efficiency. Yours may be only in the 75% to 80% efficiency range. Making your job even harder, tight budgets are putting increased scrutiny on capital spending, often leading to the postponement of infrastructure upgrades such as new boilers. You're left with aging, inefficient equipment.

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However, there is another way to achieve more efficient operation: you can retrofit your old boiler to bring its performance nearly up to par with today's new systems.

### *Retrofit vs. New*

Before you decide to retrofit a boiler, you must first consider the maintenance the current system has received. If the boiler hasn't been maintained well, you'll probably need to replace the entire system, whereas if the boiler has been maintained on a regular basis, retrofitting likely will be the best option. To make this determination, have a professional inspect the boiler.

New equipment is nice, but never underestimate the value of regular maintenance for controlling energy costs. Something as seemingly minor as a compressor working too hard and losing flow through dirty air filters can cause a boiler system to work inefficiently. Often, employees forget to check filters or they wait until they look dirty, which is usually several months too late.

While retrofitting is initially less expensive than purchasing a new boiler system, you must also consider whether retrofitting is the most cost effective answer in the long run.

### *Budgeting for Retrofit Projects*

Once you determine that retrofitting is the way to go to add efficiency, company executives need to begin financial planning for the upgrades.

Every company budgets differently, so there's no one way to prepare financially for boiler system upgrades. While some companies may have a reserve fund for upgrades, others may need to research their options and begin allocating money to the project.

You can spot when a retrofit might be needed by reviewing monthly energy bills and usage and monitoring control readings. By paying close attention to the warning signs of inefficiencies, you can help the company prepare financially for the projects.

Until two years ago, boiler system users were most concerned about emissions from their boilers, There are still 400 counties in the country that are considered non-attainment zones for air quality, meaning they don't yet reach the current U.S. Environmental Protection Agency standards. Meanwhile, every state has its own mandates on how much emissions may be released into the atmosphere. In some states, such as California and New Jersey, the mandates are even stricter. If your boiler cycles on and off, or doesn't have the right control regulation, you're risking fines for pumping more emissions into the air than your state allows.

While emissions are still an important issue, the recent dramatic rise in fuel costs has shifted the focus for many facilities. Boiler system users are seeking ways to reduce fuel consumption, which is primarily accomplished by increasing efficiency. Most retrofitting projects are driven by increased fuel cost, but other are necessary because of state efficiency or federal EPA regulations.

Through increased fuel efficiency, payback on retrofitting projects can be one year or less. As you will see in this article, retrofitting can produce savings—depending on the project—of anywhere from $5,000 to $75,000 or more on their fuel costs.

### *Identify What's Causing the Inefficiency First*

To improve boiler efficiency, you first must identify your efficiency problems. The main cause of energy inefficiency is system heat loss. The average level of efficiency for industrial boilers is 75% to 77%, with roughly one-quarter of fuel producing heat and energy that is never harnessed.

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If retrofitting is the best option, the first place to implement improvements is in your control system. New developments in boiler controls create opportunities for substantial efficiency gains.

Boilers must operate with an excess supply of oxygen in the combustion gases to ensure complete combustion for the fuel, thereby yielding maximum heat energy. However, too much oxygen cools the flame, and too little leads to incomplete combustion. Therefore, control of the air and fuel levels is paramount to optimal efficiency. The control options listed below are available for retrofitting into an existing system to produce measurable efficiency increases and fuel-cost decreases.

Many boiler burners are controlled by a single modulating motor with jackshafts to the fuel valve and air damper (commonly referred to as "jackshaft control"). 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 4% to 7% oxygen in the stack. This oxygen level reduces boiler efficiency and, over time, linkages wear—making repeatability impossible.

To fix this problem, facility engineers can incorporate parallel positioning into the boiler's control system. It's a process using dedicated actuators for the fuel and air valves. Air and fuel position curves are programmed into the PLC for each actuator and repeatability is excellent. Boilers that incorporate parallel positioning need only 2% to 5% excess oxygen in the stack to ensure complete combustion.

In general, boiler efficiency increases by 1% for each 2% reduction in excess oxygen. Using this rule, a 600 hp boiler with parallel positioning and 2.5% excess oxygen will be approximately 2% more efficient than a similar boiler operating at 6.5% excess oxygen.

That equates to a savings of $10,700 per year (based on operating at 50% average load for 12 hours per day, 365 days per year and a fuel cost of $10/mm BTU).

### *Small, Yet Effective, Retrofit Options*

In addition to the above options, there are a few other tools facility engineers can use when planning to retrofit a boiler system.

Additional but smaller savings can be obtained by insulating steam piping like condensate return lines, boiler feed water lines and other piping runs.

Many boiler rooms have steam and/or condensate return liens that are not completely insulated. Without insulation, a 4" diameter, 30-meter pipeline at 150 psig loses 850 mm BTU/year, costing almost $13,000. Approximately 90% of this loss can be saved through insulation.

Another option is to blowdown heat recovery. All boilers must remove dissolved solids from the boiler to maintain water purity and ensure a long boiler life. The frequency and duration of each blowdown cycle equates to approximately 3% efficiency loss.

Many boiler rooms route blowdown to a flash tank, which 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% of this energy.

*—by Dan Willems, Vice President-Product Development, and Wendell Pipken, Controls and Conversions Manager, Cleaver Brooks, Inc. (www.cleaver-brooks.com)*

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