Making the O&M Comparison of Gas vs Oil

The Results May Surprise You

AT A GLANCE

- Owners may underestimate O&M costs
- Simple stack testing doesn't tell full efficiency story for oil
- Long chain of parasitic energy losses
- Operational complexities increase

Choosing between natural gas and oil-firing for boilers involves complex decisions. Bill Bloom, sales manager at Burnham Boilers, indicates that facility managers regularly face this decision, and need to consider the full cost of ownership of either type of system. "It's not just first cost, and not just fuel cost. The decision needs to be made on the full expected long term cost of the system." This includes operating and maintenance (O&M) expense.

Much useful work in quantifying the full cost of operation of oil-fired vs. gas-fired boilers has been done by Dr. Herbert Eckerlin, from the Department of Mechanical and Aerospace Engineering at North Carolina State University in Raleigh. He observes that the frequent practice of estimating the efficiency of an oil-fired boiler by doing just stack testing ignores a long list of additional parasitic energy losses unique to oil-firing.

He feels these costs typically add an additional efficiency penalty of six % or more, depending on the type of system, its geographic location, and the exact characteristics of the fuel. Eckerlin's work has extended over two decades and has involved studies of over 100 commercial, industrial and institutional boilers throughout the U.S.

HEAVIER OIL GRADES INCREASE O&M

Oil fuels come in a number of grades, with heavier grades having a lower Btu cost than lighter grades, but requiring more complex systems for handling, storage, mixing and preheating. Yet, compared with natural gas, all liquid fuels require considerably more complex pre-combustion systems. Here are some of the elements.

Unless you are the rare user who can receive liquid fuel by pipeline, you will need a storage facility — a large oil tank, or tanks. Storage requires rail or road access for delivery and systems for fire and spill protection. Many users of liquid fuel will also have a smaller "day-tank" closer to the boiler for immediate fuel needs. This will occupy plant floor space, which could be used for other purposes.

COSTS OF STORAGE

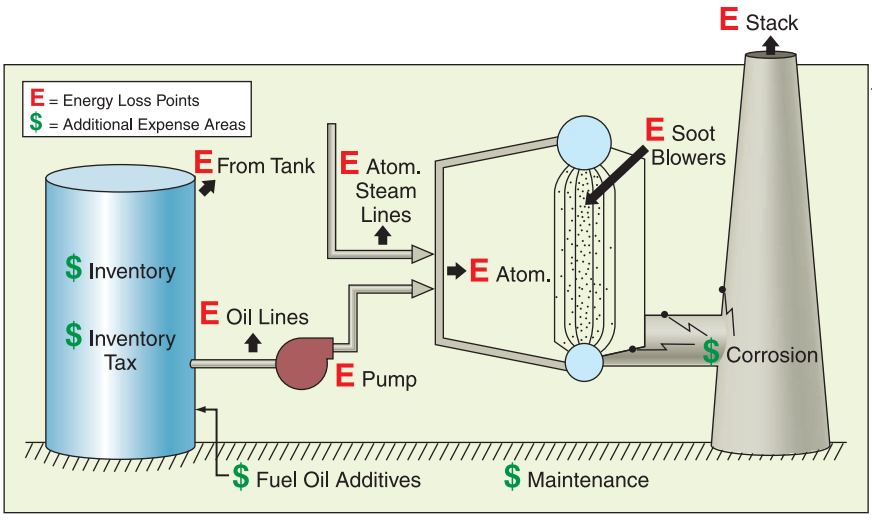
Eckerlin notes that many storage systems include a provision for fuel circulation within the tank, especially with the heavier grades of fuel. This is not only an initial expense, but also means pumps and motors to inspect, maintain, and perhaps periodically to replace. Remember to include the energy expense for pump motor operation as well. This is just the first of multiple small motor operating expenses that can add up to a significant electric energy cost, and additional maintenance responsibilities.

Many oil fuels need to be heated during the cold weather, with the heavier grades needing more heat input. Grade #6 (often called "Bunker C") typically needs to be held at 125° F in storage year-round. Remember to include the energy cost of steam coils for heating. Eckerlin observes that temperature control in these tanks is often poor, and he has seen oil stored at temperatures as high as 200° F. He points out that it's not just the energy needed to bring the oil to temperature, but also heat losses through tank walls that need to be accounted for. If the tanks are poorly insulated, the energy cost for heating stored oil can be substantial. Eckerlin indicates that there is great variation in the heating energy needed, depending on fuel type, location and construction of the storage tanks.

Then there is the delivery system to bring fuel from the storage tank to the day-tank, and from the day-tank to the boiler. It's the issue of necessary additional pumps, motors, and exposure to risk from equipment failure. Some owners recognize the critical nature of this system, and keep replacement pumps in stock. Immediately before the burner, heavier oils are further heated. For #6 oil the goal is usually to preheat the oil to 200° to 225° F to promote proper atomization.

ENERGY COST OF ATOMIZATION

Once the fuel is at the burner, oil needs to be atomized — dispersed into the tiny droplets that permit efficient combustion. This requires an additional energy input either in the form of steam or compressed air, plus more exposure to mechanical failure. According to Bill Bloom from Burnham Boilers, atomization equipment is usually included in the oil or dual fuel burner



package, and contributes to higher initial expense for these burners designed for oil combustion.

Eckerlin's work emphasizes that at the post-combustion stage, there continue to be additional expense involved with oil. Oil burning vs. natural gas entails increased accumulation of soot in the boiler. This accumulation reduces boiler efficiency, and the boiler must be periodically cleaned, whether by soot-blowing in the case of water tube boilers, or through periodic maintenance cleaning. Soot-blowing is usually done with either steam or compressed air. In either case, there is an energy input.

SOME LOSSES CAN BE SUBTLE

Eckerlin demonstrates the subtlety of parasitic losses in pointing out that the steam used for soot-blowing requires the addition of makeup water to the boiler. He notes, "This water supply needs to be heated to the temperature of the condensate return, and thus requires additional fuel for the boiler. This is another loss that doesn't show up in stack testing." The cleaning requirement can extend to downstream elements including air heaters, and emission control equipment. And of course when the boiler is down for cleaning, it is not available for production.

Further, in their calculations, owners need to consider that with natural gas, you pay for the fuel as you use it, where with liquid fuels you pay for it as you buy it. The larger the amount of storage you are putting in, the greater the pre-use payment penalty.

OWNERS MAY UNDERESTIMATE O&M COSTS

Do most facility operators understand the O&M expense penalty with oil? "Probably," says Bloom, "Though they may underestimate the magnitude of the costs that can be involved." Many of the individual expenses described above make a relatively small contribution to the total, but together can add up to a significant differential. This will, of course, vary from site to site, and with the exact fuel characteristics of the oil available. Eckerlin's research indicates that parasitic energy requirements are often in the area of a six % additional cost differential for oil fuels over the stack efficiency calculation. This six % experience does not include additional maintenance costs such labor and loss of boiler availability during cleaning operations.

Is this enough to make a difference? Perhaps so, especially if you add in the additional risks for system failure and the need for extended operator vigilance. According to burner manufacturers, buyers of new burners seldom switch from gas to oil, but often go the other way. Eric Graham from Gordon-Piatt Burners, a John Zink company, notes, "We are always trying to increase the reliability of our burners. Gas burners are simpler, and that contributes to their lower cost and high reliability."

DUAL FUEL BURNERS HAVE THEIR PLACE

Today, there is a continuing market for dual fuel burners. These allow the operator to switch from gas to oil. Graham says these are especially popular with healthcare systems, which place a high value on system redundancy.

In these dual-fuel systems, some of the O&M costs for oil pertain, such as the need for a storage system, inventory, heating, and circulation. However, with oil as a secondary fuel, the storage requirement and related energy costs can often be much smaller. Other costs, such as atomization, boiler cleaning, and pumping, are largely avoided, except to the extent the oil system is used. Bloom feels that about 10% of the gas-fired market in mid-sized boilers is putting in dual-fuel systems.

URGED TO CONSIDER FULL COST OF OIL O&M

The point of this discussion is that as you and your engineer look at equipment replacement strategies, it is important to include the full costs of both choices. It isn't a simple apples-to-apples comparison: These are two different energy sources with many other inherent different characteristics. Just remember to include those attributes of oil-fired systems that are easy to forget — and be sure to look at the full cost of operation and maintenance for both fuels. ‹GT›

Look at all the Factors

One facility manager that goes to extra efforts to understand the true cost of oil vs. natural gas is Kurt Bresser at Temple University in Philadelphia. The University has two steam plants which are normally fired by natural gas but have a dual-fuel capability because of an interruptible gas contract with the local gas utility, PGW. Bresser says he has the option to switch to oil at any time, but needs to know the full cost of that decision. He looks not only at the parasitic energy losses, but also considers that he has to have two workers in the mechanical room when firing oil, but just one with gas. Another reality is that the emission charges from the local air quality district are three to four times higher with oil. Bresser says, "It's an economic decision, but you need to look at a lot of factors. Usually, gas comes out ahead."