Combustion System Management: A Methodical Approach

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Measuring the performance of the equipment you currently use will help identify savings opportunities as well as equipment that is safe.

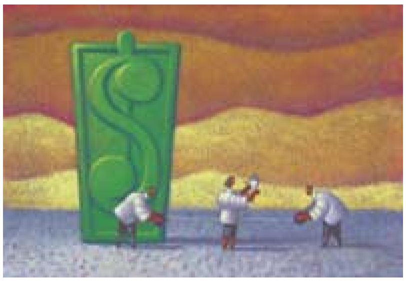
We all know it is difficult to compete in the world market. Manufacturing costs, health care, raw materials and energy are on the rise, while foreign labor costs often are a fraction of those in the United States. To compete, domestic manufacturers need to take advantage of every opportunity to reduce costs and improve productivity.

The good news is that most facilities have opportunities to improve the efficiency and effectiveness of their process heating equipment. The challenge we all face is how to best identify, evaluate and execute worthwhile projects.

It is not as simple as placing a suggestion box in the plant or having a brainstorming session on how to improve a process to reduce the energy consumed. While these ways may yield some valuable insights and identify worthwhile projects, a more methodical approach is required to ensure the organization invests its resources in the most effective manner.

The first step in developing a plan is to measure the current equipment performance to identify savings opportunities. In order to develop an understanding of how best to reduce the cost of operating process heating equipment, the current operating costs must be determined. Direct costs consist mainly of utility, maintenance and operating costs. Utilities include electricity, fuel gas or oil, compressed air, steam and water. Other direct operating costs that should be captured include labor and materials to maintain and operate the system.

Getting Started



Prepare a list of the systems to be evaluated. Use your experienced staff to rank which units may yield the best opportunities to save money. Once a list is prepared, create a spreadsheet for each piece of equipment that includes all the costs you believe are significant. The following questions may help identify what to measure:

- What is the quantity and cost of the utilities consumed by each process? How much of this energy is base consumption (required to overcome losses) and how much is attributable to each unit of production? Utilities include fuel gas or oil, electricity, steam, compressed air, and cooling water.
- How much does it cost to maintain a given piece of machinery?
- What is the uptime of each piece of machinery, and what is the cost of lost production when a given piece of equipment fails?
- Are the systems well suited to the process? Are they properly sized? Do they properly support the process?
- Is each piece of equipment in compliance with applicable safety standards?

Once you know what to measure, the next step is metering. Too often, utilities are supplied to process heating equipment and building heating equipment from the same meter or system. Plant engineering personnel know what the total consumption is but cannot allocate it with any confidence to either process heating or facility heating. The result is a limited ability to predict the return on investment (ROI) from an energy-saving project or to measure the return from a project that has already been executed.

The solution is to examine how utilities are distributed within the facility. Are there locations where small, permanent meters can be installed to break down utility consumption by function or area? On equipment that consumes a large amount of utilities, consider installing dedicated meters.

Create groups of similar types of equipment. If you have 20 natural-gas-fired air makeup units on the roof of a plant, they may not consume too much fuel gas individually, but grouped together, their consumption is significant.

Methods to Meter Utility Consumption

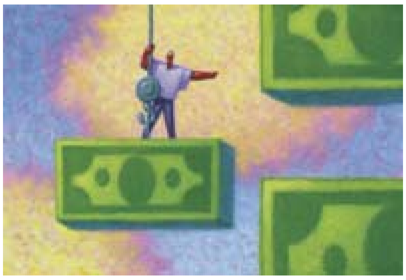
One method that has been used to measure the consumption of a particular piece of equipment is to install dedicated meters in the various utilities supplies used by the device. This may not be cost effective or possible. Consider other methods:

Share Meters Among Various Pieces of Equipment. Install meter connection points and study typical units in each group. This method provides good data for the time in which you make the study; however, changing production rates or environmental conditions may invalidate the data. If you use this method, measure holding consumption when the unit is at temperature but idle, and measure consumption when the unit is in production. If you divide the difference between the consumption while in production and the consumption while at idle divided by the production rate, you will have an idea of the incremental cost per unit production.

Utilize the Equipment's Controls to Measure Energy. Much of the currently installed base of process heating equipment is equipped with some type of programmable control. It often is possible to add additional software to these systems to measure energy consumption. If the unit has an on/off heating system, timing the "on" period and multiplying this value by the gross energy input value will give you a good approximation of the total energy used. If the unit uses a variable heat input, average the input value over a given interval to approximate the total energy used. Motors with variable loads can be equipped with current transducers, and the "on" period of motors with fixed load can be timed and multiplied by the electricity consumed.

"Case Study" a Piece of Equipment. Use the U.S. Department of Energy's Process Heating Assessment Tool (PHAST). The tool will assist you in collecting and analyzing utility costs. You also can use it to create "what if" scenarios to estimate the return from various equipment improvement projects. The software tool and training opportunities can be found at the DOE's Energy Efficiency and Renewable Energy's web site at http://www.eere.energy.gov. Plan to spend some time looking at the other tools and resources described on this web site.

Other Factors to Consider



Personnel and Maintenance Costs. Collect information about the cost to operate and maintain the equipment. This is an important step. It may make no sense to upgrade the burner systems on a piece of process heating equipment if its structure or insulation is worn out. It may make more sense to replace the unit entirely. For another piece of process equipment, a small investment in modern electronic control devices may make the old unit perform like a new design. The advice of equipment suppliers often may prove valuable if properly evaluated.

Suitability. Another factor is to ensure that the equipment is well suited to the process. For example, if a system was designed for long, continuous production runs and the plant has shifted to shorter, varied runs, the equipment may be oversized or take too long to change temperatures. Production equipment often is added during periods of increased production, and the possibilities of a decreasing or more varied type of production gets ignored in the analysis.

Safety. Take advantage of this process to review the installation, wiring and function of the safety components on your equipment. Is the safety system properly designed and compliant with current NFPA standards? Has it been modified? When was the last time the safety devices were checked? An outdated or faulty system must be upgraded or replaced -- safety compliance alone may determine which piece of equipment is the first on the list to be modified or replaced.

Compile Your Data. Upon completion of your study, informed decisions can be made defining how and when to invest resources to improve operation efficiencies. If the data gathering was performed properly, the return on the required investment can be estimated accurately. It is now time to outline projects.

In my next article (published in the August 2004 issue of *Process Heating*), I'll show you the example of "ABC Co.," a fictional company, as it uses the concepts identified in this article to begin to look at process heating equipment from a life-cycle standpoint. Follow along with ABC Co. and take your company to a stronger bottom line.

Sidebar: A Side Benefit

One of the unexpected returns provided by an effective and ongoing energy-monitoring system is the ability to identify malfunctioning equipment. Heat exchanger fouling, combustion systems drifting off-ratio, leaking valves, failed sensors or poor temperature control all may result in an unexpected increase in the energy consumed by a given process. These conditions are not only costly but may lead to potential safety problems.

Proper monitoring may provide plant engineering with the ability to anticipate equipment failures before an interruption of production occurs. A second major benefit may be realized in discovering areas of concern involving plant safety for both personnel and equipment.

Apportioning energy costs to production areas and processes will provide a better idea of how much each product costs to produce. This knowledge will certainly help managers make the decisions required to optimize the plant's profitability.

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