Thinking small yields big payback

Take advantage of power cost and receive cheap heat for your process

That small furnace in your process plant is one of the toughest pieces of equipment to make efficient. Sometimes these fired heaters aren't efficiently designed because of the cost to put in the latest control systems and maintenance. While a very large furnace can pay for itself with a 3% to 5% efficiency improvement, the return on investment doesn't seem to favor anything but manual controls, simple patches, and an occasional operator burner adjustment for small units. However, dollars lost from these heaters are adding up.

Although it normally isn't possible to justify building a new replacement furnace, the more available and easier to install small gas turbines pose a unique opportunity. You can now justify a new style cogeneration facility where the turbine exhaust doesn't go to making steam, but provides process heat for your small furnace.

When most people think about cogeneration plants, they usually envision a large facility that provides most of the electric needs for a process plant and high pressure steam for process heating. Because such plants are so expensive, they usually require board approval; questions about core competency and process focus have killed many potential projects.

What if instead of a large gas turbine generator, you install smaller generators that produce a fraction of your electrical needs? Couple that smaller generator with a small furnace and you can produce a tremendously efficient process that saves energy as well as reduces cost.

Let's say the price of natural gas is $10 per MMBTU. In our example, a fired heater needs to provide 50 MMBTU/hr of process heat. Heater efficiency is 66.7%, so it burns 75 MMBTU/hr of natural gas to deliver 50 MMBTU/hr of process heat. Total cost is $750/hr or about $274,000 per year.

To make this heater 80% efficient takes 62.5 MMBTU/hr of natural gas to provide process heat. Total cost is $625/hr or $228,000/year. The savings would be $46,000 per year. Few companies justify a lot of projects with $46,000 savings.

On a natural gas BTU basis, the equivalent efficiency can vary between 20% to 40%. So, let's say that you run your process unit, you also need the equivalent of 35 MMBTU/hr of electricity, approximately 10 MW, and you're buying it at a very efficient 35%. You're paying for 100 MMBTU/hr of natural gas or $1,000/hr or $365,000 per year. Add that to your process cost, and the electricity plus process heat costs $639,000.

Instead let's install a 10-MW gas turbine that exhaust into your heater box. The gas turbine feeds 100 MMBTU/hr of natural gas and produces the equivalent of 35 MMBTU/hr of electricity. The exhaust from the turbine provides 50 MMBTU/hr of heat to the process with 15 MMBTU/hr lost. So, instead of paying for 175 MMBTU/hr of natural gas, you pay for only 100 MMBTU/hr.

From a process heating perspective, you revamped a 75 MMBTU/hr heater and received electricity that normally cost 100 MMBTU/hr for 25 MMBTU/hr. A 75% savings on your electric bill! Or for the price of normal electrical use, your process heating is free! Either way, it's a $274,000 annual savings.

Why haven't plants just flocked to this technology? First, it's difficult to find companies that sell this modification. There's no current demand for the product. Although the savings are tremendous, modifications to small furnaces haven't been a big seller. Very few companies will even look at your small furnace to see if a retrofit is possible.

Second, people are worried about reliability. Adding the turbine ties your process to that moving part. To offset this, the current burners would need to be maintained to run the furnace without the turbine, if needed.

Third, although it's the same furnace, because the method of providing heat has changed, it becomes a new environmental source and although there're incentives for installing energy efficient equipment, a lot of companies don't want the permitting hassle or the possibility of having to add environmental equipment.

And finally, it isn't your normal operation. Yes, cogeneration has been around for a long time but a small-scale turbine hooked directly to a process just hasn't been accepted.

However, this is a new area that should be explored. Whatever the scenario, taking advantage of power generation can really alter your process heating landscape.

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PQ: Installing smaller generators which produce only a fraction of your electrical needs is a new area that should be explored.