A Paradigm Shift IN BURNER TECHNOLOGY

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This business isn't exactly rocket science. Most of the technology is old school, tried-and-true, and hasn't changed all that much since the early 20th century. I mean, how much has Boyle's law changed in the last 200 years?

But every once in a while, something comes along that shakes up the status quo. A technical advance is made, and all of the sudden the game changes. The shift to digital controls is one of those game changers, as was the application of the centrifugal compressor for refrigeration way back in the 1920s.

Oil free technology such as the Turbocor compressor, or low-oil compressors such as the Carrier three-rotor variable speed screw compressor used on the new 23XL chiller line are part of the new wave of innovation. Game changers, they are called.

Boilers, for the most part, stopped major development in the 19th century. Forced induction is a 19th Century technology. Most development has come in the controls department, and that only in the last 15 years. Boilers, like most technologies, have been forced to grow more efficient as fuel costs have risen. For the most part, the applied technology to achieve that increased efficiency has been available for many years. It was just too expensive to install when weighed against potential fuel savings. The more expensive the fuel, the more investments in efficiency.

As I said, it's not rocket science.

Typically a boiler's combustion mixture is set up with cams and linkages off a single actuator, and the mixture (see my "Combustion" article in the Winter 2008-09 issue) varies little across the operating range. There is still a lot of "slop" in the control of the mixture.

The latest advancement in burners has been independent control of the fuel and the air mixtures, each with its own actuator. This allows more exact control of the fuel to air mixture. Dual controls are vastly better, but there are still intrinsic, built-in inefficiencies to the basic forced induction (power) burner. If a burner at its best can only produce 5 percent O^2 at low fire and 8 percent O^2 at high fire, no amount of controls in the world will help those numbers. They are the best you can possibly get. The restriction in gaining of efficiencies is now resident with the burner.

Recently there has been a development of some new technology that bears investigation. Developed and placed on the market by Limpsfield, a British company associated with Autoflame controls, Limpsfield has made one of those "game changing" breakthroughs. In the business world, they call this a paradigm shift. (Which is pronounced "pair-a-dyne", don't ask me why.)

They are able to guarantee a 3 percent O^2 reading *across the operating range.* Or less. In the world of boilers – remember this stuff hasn't changed much since the 19th century – this is a paradigm shift. Can't get much better efficiency.

Like anyone, I am skeptical of "magic" devices that improve the operation of equipment. You have seen them before. Lots of marketing flash for that special oil, or the special refrigerant, or the fabulous widget that will save lots of energy and money, improve your love life, and make you a hero to the boss and the EPA. Uh-huh. However, this one seemed different. Didn't have the marketing splash; they were actually kind of low profile. But one thing really got my attention. The company has a written guarantee where they promise a 3 percent O^2 level *or less* across the operating range.

How do they do it? Like many things now, the advantage comes from computers. Ultra-fast computers allow advanced 3D modeling of gas flows. By modeling these gas flows, and then proving the computer results in the lab, they have been able to radically change the method of mixture for pre-ignition gas and air. To get all technical: the efficiencies are achieved by the modeling of stochastic (chaotic, random) dynamical processes. Combustion is one such process. An 85 percent mixing of the air/fuel ratio is achieved before the mixture is ignited.

Oddly enough, most burners on the market today were invented before these engineering and math advances were even thought of, mostly in the mid-20th century.

Oh. And they do it with no moving parts.

Paradigm shift is the word for that sort of thing.

Some of the most successful boilers installed in this country are manufactured by Cleaver Brooks. These are truly great boilers. Rugged, high quality, compact, sturdy, and reasonably efficient for their design. One of the large drawbacks to these boilers is the fact that owners are locked in to a Cleaver Brooks supplied burner. Unlike many boilers (Superior, Kewanee, Burnham, Ware, etc) where you can mount just about any burner from any company to them, the Cleaver Brooks boilers are limited by their style of combustion air fan to almost no other aftermarket burners. Limpsfield burners are adaptable to the unique requirements of the Cleaver Brooks boilers, which brings the savings potential to a great many who didn't have it previously.

Downside to these burners — like many bits of new technology — is they are not cheap. Lead times are longer that other "off the shelf" power burners. But if you have a large enough boiler, and/or you have a year-round load, the savings generated by the retrofit are great enough where the installation takes on the status of a "no-brainer" — the kind of project the number crunchers love to see.

So there you have it. No moving parts, paradigm shifts, written guarantees of performance, unmatched efficiencies achieved by the modeling of stochastic (chaotic, random) dynamical processes. Advanced 3D modeling and major math.

Hmmm. Maybe this stuff *is* rocket science.

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Mark Huston is a regular contributor of the Engineers Column and frequent articles for this publication.