Andy Pearson

Business, as Usual?

BY ANDY PEARSON, PH.D., C.ENG., FELLOW ASHRAE

I stuck my neck out recently. Not in a radical, adventurous way, but as more of a naysaying churl. However, the past is littered with elder statesmen who confidently decried new ways of thinking, from powered flight, to X-rays, to quantum mechanics, so I'd like to put my negativity into a positive context, because I believe that there are very valuable and economically precious lessons to be learned.

What I said was in most forms of refrigeration, from domestic to industrial and encompassing chillers and air-conditioning along the way, the vapor compression cycle will continue to dominate all types of systems to the almost complete exclusion of all other novel, "not-in-kind" technologies. This is not a very exciting message, and it is not intended to diminish the efforts and achievements of the many researchers and developers who are making progress with new systems, but it is based on simple observations and sound logic.

New, improved wheel, now with added corners.

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Vapor compression is the familiar system where a liquid is boiled at a lower pressure to make something cold and the resulting gas is compressed to a higher pressure and then cooled to turn it back to liquid at a higher temperature. The high pressure liquid can then be lowered in pressure, usually by squirting it through a small hole or a narrow pipe. This is sometimes called "The Perkins System" after Jacob Perkins who patented the idea in 1834. There is a wide range of "not-in-kind" alternatives; I don't intend to name any of them here because I don't want to suggest that I am picking on a specific few. I think these observations apply to pretty much all of them: if the cap fits, wear it.

The obvious advantages of the Perkins cycle are that it is simple and well understood. It is so simple that it has been built into equipment ranging from personal cooling suits up to multi-megawatt industrial complexes. Operation of these systems is relatively easy and compared to most other technologies we use daily they are also incredibly reliable. The service interval on a typical Perkins cycle compressor is the equivalent of driving a car 750,000 miles (1.2 million km) and many compressors go two or three times that distance without an overhaul. There are some less obvious advantages, too. Pretty much every "not-in-kind" device creates a warm zone and a cold zone within a single machine. To deliver the cooling to a remote location, like an office, classroom or operating theater, or over a wide area, like a refrigerated warehouse, a secondary heat transfer liquid would be required; usually water or a glycol solution. Similarly to take the heat away from the device a secondary fluid (perhaps water or glycol, but sometimes also ducted air) is required. Big not-in-kind systems need, I think, more fans and pumps than a direct Perkins cycle. Now many medium-sized Perkins cycles, such as chillers, are indirect systems but the majority of small and large systems are direct. The cold end delivers cooling directly to the people or process or stuff that needs to be cooled and the warm end releases the extracted heat directly to the outdoors. The addition of secondary heat transfer is expensive and inefficient, but these disadvantages rarely seem to feature when a "not-in-kind" technology is being promoted as the next greatest thing.

Perkins cycles also have disadvantages. Most Perkins cycle compressors require a lubricant—what I have previously described as a "necessary evil" (*ASHRAE Journal*, November 2012). The majority of maintenance activity, with the subsequent breakdown and repair, is related to lubricant issues. The expansion process is also quite inefficient, although cheap. Perhaps more of our research effort should recognize that Perkins is here to stay and should be directed toward tackling these disadvantages, not reconfiguring the wheel by adding corners to it. ■

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