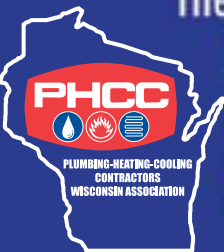


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Winter 2012

The Wisconsin

# P-H-C CONTRACTOR

The official publication of the PHCC Wisconsin Association and Master Plumbers/Heating & Cooling Contractors of Wisconsin



## COMMERCIAL SYSTEMS *flow*

THE KEY TO OPTIMIZING SYSTEM EFFICIENCY



INSIDE:

Flushometers

Marketing  
Myths Busted

Optimizing  
System Efficiency

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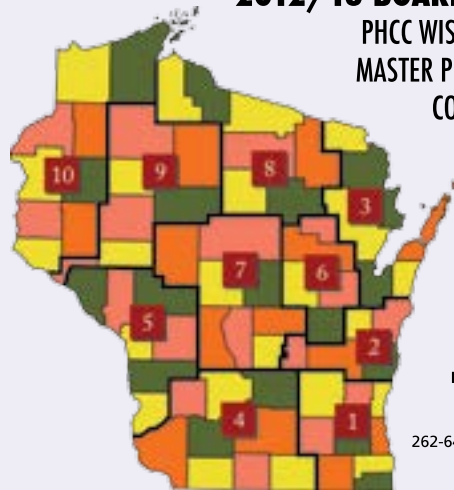
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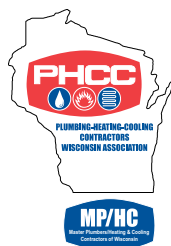
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# COMMERCIAL SYSTEMS *flow*

THE KEY TO OPTIMIZING SYSTEM EFFICIENCY BY JOHN VASTYAN



*a*s hydronic and domestic water systems age, or come on line for a tune-up, piping and pumping strategies and the condition of infrastructure are scrutinized by experts. Though the close inspection of operation and efficiency likely won't inspire a "Mechanical Systems CSI" television series, there's certainly no lack of interest by commercial system pros.

It's the sort of shake-up that's sure to happen as pipes approach their second or third decade, when buildings are renovated, and when new technology avails a better way of doing things.

Within the commercial, piped world, new technology has emerged and now takes center stage: smart, variable speed pumping.

Why all the attention? Because the benefits are so numerous, impacting overall systems, key components, operational efficiency and performance. Some experts believe that what we're seeing now is the broad application of technology whose time has finally come.

And, best: it's all about flow. Not ECM motors, a new pump impeller design, or high-tech pipe lining, or pipe-joining technique.

There's no more important, all-encompassing facet to the design, installation or retrofit of large, pumped water systems than to reduce flow to its essential need.

Two experts, both well recognized in their fields, share their insights about this newly-piped world: Watts Radiant's John Sweaney, hydronic product manager, and Taco's Bryan Payne, Southeast commercial regional manager.

## HYDRONICALLY SPEAKING

Sweaney, who's studied large system flow for nearly two decades, says that, whether it's flow on the heat-source side, or flow on the load side, there's a huge focus on energy efficiency, and fluid flow is at the center of the movement.

"Many things can be done to minimize flow, yet maintain or optimize comfort or performance – that's the key," said Sweaney.

"We often look at Delta Ts [or "ΔT:" the temperature difference between supply and return water temperatures]

from a design standpoint, especially if it's a commercial system like a shop, warehouse, or snow melt system. Installations like these call for larger Delta Ts – 30 degrees or more – which reduce system pumping requirements."

Cooler return water temperatures also play nicely into the use of efficient heating systems, like modulating-condensing boilers which purposefully

"A change in Delta T for a snow melt system could mean the ability to cut the flow rate from 40 gallons a minute to 20 so that instead of two-inch distribution copper, it could be reduced to 1.5," he continued. "This could also mean a reduction in the size of the distribution manifold and smaller radiant tubing or, perhaps, a more frugal layout."

**IT'S ALL ABOUT *flow*.  
NOT ECM MOTORS, A NEW PUMP IMPELLER DESIGN, OR  
HIGH-TECH PIPE LINING, OR PIPE-JOINING TECHNIQUE.**

harvest BTUs from condensation that forms within the system, geothermal heat pumps, and water-sourced heat pumps.

Though ideal Delta Ts for most hydronic systems is a comfort/consistency issue, targeting 10, 15 or 20-degree ΔTs, many larger systems can be designed to meet the very most basic comfort or performance requirement while conserving energy across the board. "With many properly-designed commercial systems we can ease-up on flow requirements to the point where fuel use, and pump size and type are substantially influenced . . . all leading toward enhanced system efficiency.

"The key exception is with snow melt systems where performance can't be compromised," added Sweaney. "I'm referring to systems that are installed to remove ice and snow in critical ASHRAE "Class III" areas like emergency room entries, hospital steps and helicopter landing pads. Typically, we do not recommend a design calling for a Delta T greater than 30 degrees, though for critical areas, the required Delta T should be 20 degrees."

When designing hydronic systems – whether radiant, snow melt, or for high-temperature fan coils or baseboards – there's a direct relationship between the ΔT and flow. "Double the Delta T and cut the flow in half," explained Sweaney.

The benefits of a reduced Delta T stretch beyond a reduced need to burn fuel at the heat source. "It extends to pumps of lesser size meeting the need and the down-sizing of piping, fittings, valves and other components," added Sweaney.

Sweaney referred to two key trends:

1. District heating and cooling with insulated PEX. "This is one we're seeing more of as the green revolution has taken off," began Sweaney. "Central, district heating applications have grown substantially over the past couple of years with the use of super-insulated PEX distribution lines to carry the BTUs between a central plant and, say, living units. New military housing developments are using this approach."

The use of insulated lines often accompanies the application of alternative energy sources such as biofuel, biogas, geothermal and solar at prisons, universities and apartment complexes. In Alaska, a military installation heats all housing units hydronically with waste heat recovered from the on-base electric power plant. Smart!

Another similar application is the use of insulated PEX, trenched underground, to carry injection loop BTUs to remote locations.

2. Variable speed pumping to enable variable flow. John Sweaney led us directly into this one, though we'll turn to Taco's Bryan Payne for insights into a burgeoning trend: the application of variable drives to all pumps, both constant and variable flow.

According to Payne, the application of variable frequency drives (VFDs) to constant speed pumps is now the fastest growing segment of the commercial pumping industry, a trend that improves the performance and efficiency of both large domestic water and hydronic heating and cooling systems.



Since ASHRAE 90.1 was adopted by many states as their energy code (early to mid 90s), the shift in the HVAC industry of applying drives to system distribution pumps has been substantial.

"The pumps most commonly retrofitted by upgrading the electrical starters to VFDs for quick payback are of larger horsepower, serving loads that vary," said Payne. "The benefits are dramatic, so we're now seeing quick response in the industry to make the improvements; it's the low-hanging fruit."

According to Payne, in the last eight years, two trends have greatly impacted the adoption of VFDs into more applications. The first is that the cost of drives is decreasing. Second:

manufacturers have rushed to add features and functionality.

The advantages to retrofitting constant-speed pumps with VFDs include:

- greater energy efficiency,
- more precise flow control,
- soft-starting and stopping of motors to prolong pump life,
- the integration of BMS communication,
- better balancing with speed control versus imparting 'false' head, and
- installing the ability to easily adjust flow to rerate energy plants when system flow gets out of balance or experiences reduced Delta T.

"Most people tend to relate the energy savings of drives and pumps with variable-speed system pumps," added Payne. "But there's a key opportunity

not as readily seen. It's the savings that can be found by balancing constant-speed pumps with a drive as opposed to balancing by controlling flow with a discharge balancing valve.

"In very general terms, most pumps are designed with a safety factor of 10 to 20 percent. This is a legitimate, useful practice that allows for flexibility to accommodate a different mix of equipment to be installed other than what was specified, or future expansion," continued Payne.

"For instance, this might mean that a pump selected at 1,750 rpm with a safety factor on the design head was installed, started up and over-pumped the system because it was designed with a 'little extra' capacity. At this point the test and balance contractor

would take the discharge balancing valve and throttle it back – imposing "false head" – to move the pump back to design flow.

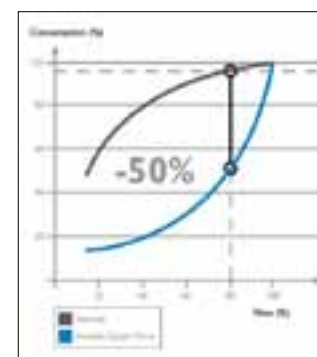
#### PUMP AFFINITY LAW

According to Payne the newer, best industry practice being adopted is to use a drive to balance the pump while using the discharge valve as a flow measuring point, not a throttling point.

Pump affinity laws help us to evaluate what the savings are for most jobs. The laws say that the change in horsepower consumed is proportional to the cube of the change in speed.

To illustrate, Payne adds, "Let's say that we can reduce the speed of most pumps by 10 to 20 percent based on safety factor. That means most pumps after start-up would only need to run at 80 to 90 percent of their rated top speed.

"Doing the math shows us that 80 percent (0.80) cubed is .512 and 90 percent (.90) cubed is .729," explained Payne. "This means that a constant



**figure 1:** THIS GRAPHIC SHOWS THE TRADITIONAL RESPONSE OF A SYSTEM PUMP HP IN CHANGES TO DEMAND/ FLOW.

speed pump set up and balanced with a drive consumes only 73 percent of design horsepower if it has a 10 percent safety factor; a pump with a safety factor of 20 percent consumes only 51.2 percent."

"These are significant energy savings," continued Payne. "Other benefits for constant speed pumps installed with drives are that they're now running at reduced speed which extends their life, and they're also soft-started as a function of the drive. This puts less wear on pump and system components. These become an advantage for the equipment and the

building owner."

"With the focus on first cost, green construction and energy optimization, our industry needs advantages like these," said Payne. "The decisions we make about design Delta T and flow balancing can have a significant positive impact on system performance."

John Vastyan is president of Common Ground, a trade communications firm based in Manheim, PA that specializes in the hydronics, radiant heat, plumbing and mechanical and HVAC industries. He can be reached at 717/664-0535. □

## THE APPLICATION OF VARIABLE FREQUENCY DRIVES (vfd's) TO CONSTANT SPEED PUMPS IS NOW THE FASTEST GROWING SEGMENT OF THE COMMERCIAL PUMPING INDUSTRY.



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