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Integrated Pump Technology

BY INCENTIVIZING INTEGRATED PUMPS UTILITY EXPERTS WILL SEE A DRAMATIC IMPROVEMENT IN THE REAL-WORLD ENERGY SAVINGS

By Mark Chaffee and John Sheff

Applying variable frequency drives (VFDs) to existing constant-volume HVAC pumps transforms them into variable flow equipment. This improvement is a well-established and increasingly popular energy conservation technique, especially popular among building managers eager to qualify for utility energy efficiency incentives.

The savings from energy retrofits to constant volume pumps, especially in commercial and industrial (C&I) settings — such as office buildings, universities, and hospitals — are often significant because of the numbers of pumps involved, and energy saved. Thanks to affinity laws, which reveal that a reduction in motor speed exponentially cuts energy consumption, reduction of energy is immediate, and substantial.

Some utilities offer "prescriptive rebates" to win the interest of building managers. Typically, these entail pre-determined dollar amounts, usually per motor HP, based on assumed energy savings. The challenge is that the actual kWh savings may fail to materialize. The problem is not with the technology. Rather, it's one of human error.

When an installing contractor buys a VFD to install on a new or existing pump motor, the installation process is anything but prescriptive. Not only does the contractor have to mount and wire the device near the pump, but he must also decide where to place the differential flow sensors in the pipe, drill into the pipe to install the sensors, program the drive, and then start it up. The mounting and wiring is something most mechanical contractors can easily perform. The sensor installation and drive programming, however, is another matter entirely.

Contractors need substantial expertise to install differential flow sensors in the proper place and to understand the application and the model of VFD well enough to accurately program it. Unfortunately, that expertise is not widely available, so many of these projects are installed incorrectly or with no modification to the drive's factory defaults to match pump or system requirements. This means that the utility, on average, is not going to see

The roof of one of Zimmerman's 500-foot long chicken houses is adorned with a 72 kW photovoltaic array, just one of many steps he's taken to make his organic poultry operation more sustainable. The heat source for his chicken houses is a manure-burning boiler located in a remote building. Three-inch water lines run underground to supply both houses with a maximum of 600 MBH each. *(Photo courtesy of Taco Comfort Solutions)*

Today, Zimmerman's two, 500-foot long chicken houses are heated with a state-of-the-art, bio-fueled hydronic system. *(Photo courtesy of Taco Comfort Solutions)*

Taco SKV3009 Self-Sensing pumps include a motor-mounted VFD to deliver precise flow and pressure. *(Photo courtesy of Taco Comfort Solutions)*

the kWh savings it prescribes, or desired by facility managers.

"It's all too common for us to see bolt-on VFDs set up incorrectly or even disabled altogether," says Jake Marin, HVAC program manager for Efficiency Vermont, founded in 2000 as the nation's first energy efficiency utility. "A properly set up pump + VFD can operate very well, but we need a simpler, more reliable option if we are going to see true market transformation."

The key to addressing this problem is for industry experts to focus on the need for and provide integrated solutions. Every major pump manufacturer offers a line of self-sensing pumps with an integrated VFD. These pumps do not require sensors installed in the pipe and come with the VFD factory-tuned to that specific pump and pre-programmed for sensorless variable flow pumping.

All the contractor needs to do is physically install the equipment in the hydronic system.

As Richard Medairos, director of commercial training at Taco Comfort Solutions, says, "With self-sensing pumping, there are no holes in the pipes for tubes or taps connecting remote differential sensors together with the pump. Self-sensing pump system design offers great accuracy for variable flow, higher energy efficiency, lower install costs and improved system stability."

Our advice is that utility managers turn their attention to the value of these effective, off-the-shelf solutions. Efficiency Vermont is one utility that has fully embraced this concept. The Efficiency Vermont program is providing enhanced rebates for pumps that "consist of a factory prepackaged and preprogrammed pump, drive, motor and integral controls package capable of varying speed and flow without the use of external sensors."

By incentivizing integrated pumps — rather that separately sold components, fully dependent on qualified field installation, and commissioning to operate properly and efficiently — utility experts will see a dramatic improvement in the real-world energy savings for their rebate dollars.

Self-Sensing Pumps Win Approval on This Chicken Farm

Leave it to a big-dreaming farmer in Lancaster County, Pa., to create a paradigm shift in the agricultural and heating industries worldwide. Chicken grower Earl Ray Zimmerman's passion is all about sustainability, and he's climbed a mountain of nutrient-rich debris to get it.

In Pennsylvania, poultry is the state's biggest business. And that means giant piles of bird waste typically trucked to fields, but that creates a lot of work, and surface runoff. While Zimmerman was exploring his options, a local energy-solutions firm helped him combine the need for a heating system with manure disposal.

Today, Zimmerman's two, 500-foot long chicken houses are heated with a state-of-the-art, bio-fueled hydronic system. His poultry houses are each equipped to organically raise 30,000 broilers, from peeps to slaughter in just five to seven weeks, requiring a lot of chicken feed. Of course, what goes in must come out.

Birds Love It, Too

Matt Aungst, co-owner of Total Energy Solutions, the company that crafted the system's design, teamed up with Taco Comfort Solutions to provide the engineering brainpower to get the BTUs where they need to be using KV series sensorless pumps. Depending on conditions, one house can call for up to 600 MBH at any time, though an average winter heat load is typically 200-300MBH/house.

When a bird flock leaves every six weeks, Zimmerman removes the chicken litter for storage. An auger feeds dry manure from the hopper into 1.5 million BTU biofuel boiler, while another removes ash remnant from its base.

The heart of the distribution system is also in the mechanical building. Two redundant pumps and their VFD counterparts sit side by side, plumbed in parallel. Above, a suspended Taco 4903 air and dirt separator keeps the water lines clean and quiet; a 125-gallon Taco expansion tank smoothes the loop out. Three-inch, pre-insulated PEX water lines disappear underground through the concrete floor to a distribution manifold between the two chicken houses.

Hi-Tech, Down on Th' Farm

Taco SKV3009 Self-Sensing pumps include a motor-mounted VFD to deliver precise flow and pressure. The pumps accurately respond to changes in system demand with no need for pressure sensors. If a main supply valve to one of the houses is closed, the pump senses the change and ramps down according to lower demand. Seconds later, the pressure gauge drops on the supply side.

Inside each chicken house, eight-unit heaters hang from the ceiling, providing water-to-air heat exchange. Automatically, the pumps react to the specific call for waterborne BTUs.

Before the SKV3009 Self-Sensing pumps were shipped, the VFDs were programmed in our Cranston, R.I., factory, according to data collected for specific flow rates, head pressures and system characteristics.

"A specific program enables the pumps to 'know' exactly what speed to run at any given time. You get tremendous energy savings this way," continued Aungst. When in design phase, Aungst calculated a Delta-T of 25°F.

The seven-and-a-half horsepower pumps are each programmed to supply a maximum of 125 GPM at 85 feet of head. Pump A runs as "duty," leaving pump B for backup. After several days of run time, the pumps automatically switch roles.

For best use of mechanical room space, the distribution piping incorporates Taco's Plus Two multi-purpose valves which combine all the valve functions normally required on the discharge side of a centrifugal pump. This includes shut off, check, balancing, and flow metering valves.

Inspired agriculture systems have the ability to produce more food with less cost and lower environmental impact. That's smart farming. **DE**

Matt Aungst, who designed the distribution portion of the project tests redundancy of the two pumps that serve the entire project. Pump A runs as "duty," leaving pump B for backup. After 84 hours of run-time, the pumps automatically switch roles. *(Photo courtesy of Total Energy Solutions)*

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