
Circulator Pumps With ECM Technology Next Trend In Intelligent Hydronics Design

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Over the last five years, circulators used for hydronic and radiant heating systems have become more energy-efficient thanks to ECM (Electronically Commutated Motor) technology. The intelligent speed control these circulators provide is drastically reducing energy use without sacrificing performance.

ECM technology has gradually attracted the attention of sustainable building proponents such as Alex Wilson, founder and executive editor of BuildingGreen.com, an independent building industry resource.

These variable-speed, ECM circulators make a lot of sense for several reasons, writes Wilson in his “Alex’s Cool Product of the Week” blog published April 10, 2010.

“One, they allow you to save pumping energy by varying the flow rate. Two, by reducing the flow, they can increase the temperature difference between water leaving the boiler and water returning – which improves efficiency – so you use less heating fuel... And three, these pumps compensate for the fact that circulator pumps are almost always significantly oversized,” asserts the 30-year industry veteran and authority on energy efficiency and environmentally responsible design and construction.

Instead, today’s most advanced ECM circulators automatically determine the lowest possible operating-efficiency point to meet

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changing system demand. Said differently, this technology provides the minimal output required to achieve optimal comfort — all without direct human intervention.

Target — 40% power reduction: To understand why this technology is so appealing, put yourself in the shoes of plumbing contractor Mike Wolking, who was asked to design a plumbing and hydronic heating system for a custom solar home in south-central Colorado.

In addition to specifying a system that could provide space heating and domestic hot water for the 2,300-square-foot, two-story ranch, Wolking's design had to consume roughly 40 percent less energy.

Completed in March 2009, the off-grid home uses 16 solar photovoltaic panels to generate all of the power necessary to fuel the radiant heat, hot water and all the modern amenities you would expect in a 21st century American household: washer, dryer, dishwasher, personal computers, and even a flat screen plasma television.

Wolking, a 12-year plumbing-industry veteran, who doubles as the lead guitarist for the Sons and Brothers bluegrass band, worked with homeowners Johnny and Gayle Ainsworth to design a heating system that would be both comfortable and energy-efficient.

In fact, one of the major challenges for the project was to power the home's heating system while using less energy than three 100-watt light bulbs. The system today exceeds this seemingly implausible goal, drawing just one-fifth of that 300-watt target — 57 watts — thanks to a revolutionary new ECM circulator from Grundfos Pumps.

First introduced by Grundfos in Europe roughly a decade ago, the ALPHA™ is an energy-optimized, 115-volt circulator that automatically and continuously adjusts its performance to adapt to the changing needs of the hydronic heating system. As a result, the ECM circulator is designed to cut power consumption by at least 50 percent and usually more, as compared with other circulators in its class. For Wolking and Ainsworth, the savings surpassed 75 percent.

Emphasis on energy savings: Wolking installed a standard 1/25-horsepower (HP) primary circulator that delivers hot water from Ainsworth's 135,000 BTU, propane-fired Weil-McLain boiler to a mixing valve and a secondary loop. Two additional 1/25-HP circulators feed the home's three heating zones through more than 3,200 feet of Uponor 3/8-inch hePEX™ (crosslinked polyethylene) tubing, buried in the basement slab as well as stapled under the main floor.

Domestic hot water was provided by a 150,000 BTU Rinnai propane-fired tankless water heater. Both the boiler and tankless unit were supported with a 12KW Gillette standby

propane generator that kicks in when the solar panels haven't generated sufficient power (or roughly 10 hours per month).

All three of the original circulators did not incorporate ECM technology, and thus provided a constant output and continual energy consumption. In fact, while Wolking's design performed effectively, its inefficient energy use placed a significant drain on the home's electric power consumption, which limited use of other appliances and devices.

"The original circulators did the job, but were energy hogs," Ainsworth remarks. "They were running all night long during the winter and depleted our solar battery bank. Each morning, we would have only 30 percent power remaining, and our goal is to maintain at least a 50 percent power reserve, so this drain was significant."

Ainsworth, a retired commodities broker, spent eight months searching for an alternative that would provide the same system head and flow rates, while consuming less energy.

Breakthrough technology: In an internet forum, Ainsworth explained his problem to other solar power enthusiasts, who recommended the Grundfos ALPHA.

In January 2010, Ainsworth called contractor Wolking back to replace the three original circulators with the high performance, low-energy-use ALPHA. Wolking, a second generation master plumber, had used another brand of circulators all his life, and was skeptical that any circulator could deliver dynamic flow rates while minimizing power consumption.

"The high-tech pump exceeded the manufacturer's claims regarding energy use, performance [homeowner comfort] and its silent operation," explains Wolking, a self-professed numbers fanatic. "Because we design radiant systems based on flow rate formulas and temperature differentials, the fact that the ALPHA can approximate real-time GPM [gallons per minute] volume gave us the ability to fine-tune the system's performance."

Intended for residential and light-commercial hydronic applications, ALPHA features the innovative AUTOADAPT™ function that automatically and continuously adjusts circulator performance to the changing needs of the heating system. The ECM circulator will automatically find the lowest possible operating-efficiency point to meet demand, notes Wolking, thereby saving both energy and money.

"For example, upon installation the 1/12 HP circulator was running at 9 gallons per minute (gpm), drawing 27 watts," explains Wolking, who now is a strong proponent of ECM circulator technology. "Two days later, the system was operating at 2 GPM and drawing 9 watts – a far cry from the constant 82 watts the original circulator required 24/7."

Out of the box, an ECM circulator will yield the same flow rate while consuming 50 percent less energy over a traditional induction-type circulator. Some ECM circulators, such as the ALPHA, use an integrated logic board to “learn” the system’s usage patterns in order to boost the standard 50 percent energy savings into the 70-80 percent range. As the valves in the different sections open or close with rising or falling demand, the ALPHA automatically ramps up or down to meet the load.

According to Ainsworth, the new circulators have indeed made a huge contribution to energy savings. Instead of draining upwards of 70 percent of the solar battery bank’s energy, the three new ALPHAs use roughly 35 percent – or half the energy consumed by the original circulators.

“The energy savings were instantaneous; almost like waving a magic wand over our solar battery bank deficit,” recalls Ainsworth. “We could have installed more solar panels or purchased additional battery capacity, but the pumps were the problem, not the system parameters.”

Ainsworth has been so impressed with the three high-performance, low-energy-use ALPHA circulators that he recently installed a fourth Grundfos pump to power an outdoor wood boiler designed to replace the traditional propane boiler and tankless water heater.

“While the traditional energy usage between conventional pumps and the ALPHA are similar, the major difference is the AUTOADAPT capability,” concludes Ainsworth. “The adaptability of the ALPHA software to anticipate system demand and adjust consumption accordingly is truly unique and the main contributor to my system’s success.”

Contractor Wolking echos these sentiments. “Fossil fuels have long ceased to simply be cheap and abundant,” says Wolking. “ECM circulators give plumbers an entirely new level of control over system design and performance. For me, it’s a game-changer.”